Scientific Knowledge: the Impact on Conservation

A thesis submitted in partial fulfilment of the requirements for the Degree

of Master of Arts in Anthropology

in the University of Canterbury

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University of Canterbury

2011

Abstract

This thesis discusses the impact that paradigms of thought have on the construction of conservation programmes. Western scientific thinking represents a distinct way of looking at the world. It accepts a separation between nature and culture and thinks that knowledge about the world can best be discovered through the use of experiments that follow a specific set of rules, the scientific method. Scientific thinking is an integral part of the world view of scientists and extends to the way in which they interact with the world. Scientific researchers design their projects in accordance with how they view nature. This leads to particular construction of the role of primates. People in the network of a conservation project are involved in this paradigm to varying degrees. The purpose that scientific thinkers put behind conservation can be in direct contradiction with that of the local people. Although all groups involved may agree that conservation is a valuable goal, the ways in which they value nature and want to conserve it can be quite different. Scientists view themselves as experts on nature and how best to conserve it, and they attempt to spread their way of thinking about nature to local populations through education programmes. Not all groups accept the scientific paradigm to the same extent and this has a wider impact on the local community and forms new causes of tension as knowledge and power shift.

I studied one particular field station, and explored how scientific thinking affected the outcomes of both scientific research and additional projects. I looked at how basing the conservation around scientific research has changed the dynamics created by a forest reserve. Finally I discussed with local people the ways in which the scientific paradigm had spread to them and how the field station was affecting them.

Chapter 1. Introduction to Conservation

Conservation efforts under way throughout the world are designed to focus on a range of areas, from entire landscape types to specific species and everything in between. Each conservation programme involves a variety of actors and is influenced by environmental, political and social circumstance. These contextual details interact with each other as well as with the way in which the programme itself is constructed. The way in which a programme is designed and the theories behind its construction impact the types of conservation outcomes that are produced.

Montane forest habitat is among the most threatened habitats in Africa. Montane forests within Nigeria are quite limited in number and size, but contain a large variety of plant and tree species, many of which are endangered, making them an area of focus for biodiversity conservationists.. On the Mambila Plateau, located in Taraba State, there are unique sub-montane to mid-altitude forests which have been contained within the Ngel Nyaki Forest Reserve. This reserve was created in 1969 in accordance with the recommendations of wildlife officers who determined that the biodiversity within the forests needed protection. As part of a lifelong interest in the region, Dr. Hazel Chapman conducted research in 2002 that compared the state of the forests of the Mambila plateau with similar surveys conducted in the 1970s of forest areas that had been set aside as forest reserves by the national government (Chapman et al., 2004:331). During the 1970s, Ngel Nyaki was patrolled regularly by forest guards and was under the unofficial protection of Jauro Patel, the chief of the nearby village of Yelwa. Hunting and farming within the forest reserve were rare, as upon the creation of the reserve all residents of the forest were relocated and hunting was banned. In spite of its continued status as a protected reserve, by 2002 the conservation of the forest was less effective. Slash and burn agriculture, cattle grazing within the forest, soil erosion and poaching had all become major problems within Ngel Nyaki. Simply setting up a reserve proved ineffective in maintaining the biodiversity of the forest.

In order to combat this failure, the Nigerian Montane Forest Project (NMFP) was formed and scientific research was added to the conservation strategy for the forest. In addition to simply enforcing the reservation of the forest, a biological research station was built on the edge of Ngel Nyaki forest in 2005, which works in conjunction with a national NGO, the Nigerian Conservation Foundation (NCF). The station has brought in both Nigerian and international

academics to study the plants and animals of Ngel Nyaki forest with the ultimate goal of restoring and conserving the forest. Through the presence of the station, and scientific researchers, the NMFP intends to make it possible to easily promote conservation at a local level as well as nationally and internationally. The NMFP has four stated aims[1]: to combine scientific research with education at both tertiary and local community level in order to develop long term sustainable management of Nigeria's montane forests, to facilitate the involvement of national and international researchers in Nigerian montane forest research, to involve the community in the management of montane forest ecosystems and finally, to work with the community in other ways, such as developing small businesses and working with schools to develop conservation awareness.

Local people can be involved in and educated on conservation through the station and the presence of NCF staff, while the international nature of scientific research can work to promote interest in the forest and increase possible funding sources for conservation efforts. Additionally, the presence of the station and the people working there can make it easier to keep local residents from engaging in illegal activity within the reserve. The conservation programme of NMFP now focuses around scientific research in the forest itself, with additional resources put towards helping the NCF engage in participatory forest management programmes in the local area.

Interaction with local people by both the NCF and NMFP is focused mainly in one village. The headquarters for the NCF at Ngel Nyaki are located at the edge of Yelwa. Yelwa village is located approximately 40 minutes walk from the NMFP field station. Farmers who were originally removed from Ngel Nyaki at the time of creation of the reserve were resettled there and have remained there, while being joined by a variety of new residents. It is also the largest village in the immediate area, and a centre of much local trade. Yelwa is the main economic benefactor of the NMFP. These benefits include school construction, a water pump, employment and additional spending at local shops by field station researchers. The majority of those employed at the field station live in Yelwa, making it one of the main places outside of the forest where the NMFP interacts with local people. People living in this village have seen the effects of both reservation of the forest and the research station, as well as being involved in any participatory development programmes related to the forest.

[1] Nigerian Montane Forest Project: Annual Report 2010. http://www.biol.canterbury.ac.nz/NMF_project/NMFP-10-Annual-Report_web.pdf

Moving the focus of the conservation programme from a forest reserve to a scientific research station changes the aim of the conservation effort, alters the interactions between actors and changes economic, political and social aspects of relations. The actual conservation of the forest is conducted in different ways and the networks of people involved adapt and change. Additionally the ways in which the forest itself is seen, and which aspects of it are important to conserve may change. The purpose of this thesis is to examine how forming conservation programmes around scientific research impacts knowledge production and programme outcomes.

Conservation policy in the forest has been designed around the theory that biodiversity is important to the continuation of the forest, its resources, and the people who live in the region. Biodiversity normally refers to genetic diversity, a range of species, varied ecosystems and regional landscapes (Furze et al., 1996:18). The interrelationships between the four are important to humans for several reasons. People rely directly on ecosystems to provide their environment, for raw materials, food and medicine and recreation. Specific species and habits are considered important socially and culturally to certain groups. Additionally these elements of biodiversity can be valued for themselves in non-human centred worldviews and the knowledge that they provide can also be valued for itself. There are six main threats to biodiversity: human population growth, a narrowing spectrum of traded products, economic systems that don't value the environment; inequity in the ownership, management and flow of benefits from use and conservation of resources; loss of traditional knowledge and legal and institutional systems that promote unsustainable exploitation (pp. 21). Anthropologists study various topics that apply to biodiversity conservation: the ways in which different people use resources; the relation of technology to nature and economic and power factors in how resources are controlled and exploited. Exploring these existing networks and interactions can help determine how and why natural resources are being used. This information can be used to determine possible paths of future conservation as well as how existing and past conservation efforts functioned. Looking at these factors also provides insight into the ways in which indigenous and introduced conservation strategies differ and how each has functioned over time. This anthropological relation with conservation extends from providing information retrieved through fieldwork, analysis of conservation plans, and focusing on the human element of conservation efforts. In this thesis I will be focusing on how one group, scientists, relate to and use the forest, how they view conservation and nature and the reasons behind this view. I will be doing only

limited analysis on how local people interact with this scientific network. Both local people and foreign scientists have an impact on the application of conservation policy in this forest, and to understand the network requires doing fieldwork within both groups and exploring the relations between the two. To what extent underlying ideas about biodiversity and nature are shared among actors involved with the forest can affect how well policy can be enacted.

Western science is a driving factor in creating the research station as a way to protect biodiversity. This makes it important to study how this scientific thought process affects those involved in the NFMP. Actor-Network theory (ANT) is a sociological way of explaining that has emerged from the sociological study of science and technology (STS) and how scientific knowledge is created. The three main developers of the theory are Bruno Latour, Michel Callon and John Law. Material-semiotic networks are considered, the notion that the relationality of entities is produced in relations is applied to both human and non-human actors (Law, 1999:4). Both human and non-human entities are given agency within the networks and are considered as factors in the formation of knowledge. Rather than explaining the why behind networks, ANT instead focuses on how networks develop and function. ANT provides a unique view for study of the sciences that is not captured by other theoretical stances and which is vital for effectively understanding how science knowledge is created and the political implications behind its creation. This method allows me to observe the culture of science and better understand the form that scientific knowledge takes at the field station (Knorr Cetina and Mulkay, 1983) as well as follow Latour's (1999) example in attempting to understand how the practice of science produces information and scientific conclusions about the forest. Within the thesis I primarily follow networks inside the field station. Although I follow some networks into the local village, I was limited in the extent I could achieve this due to the need to use a translator. Networks also spread throughout Nigeria and back to the home universities of the researchers. By limiting my focus primarily to the field station itself I may miss some connections, but given the limited time for fieldwork I got in-depth research at the point where scientists interact directly with the forest rather than following the data all the way back into the academic and political realms. As the scientists involved in research at the field station are all invested in the academic science realm, I have chosen to focus on how a single worldview influences the network rather than comparing the different worldviews that are involved at various points of the network. I use ANT in this thesis as a way of exploring how scientific thinking is involved in the construction and running of the field station.

Picture 1: The Field Station.

Conservation within Sub-Saharan Africa

In order to discuss the effect of scientific thinking on a conservation project it is necessary to first discuss the history of conversation within sub-Saharan Africa. A regional focus is necessary due to the impact that colonisation by Europeans has had on both the environment and the techniques and ideas that have been used to respond to perceived environmental problems. Tracing the history of conservation efforts in Africa will make it possible to understand the factors that led to the creation of the forest reserve and later the biological field station that is at the centre of this thesis. I will be using an anthropological framework to discuss these conservation efforts and the reasoning behind them. Additionally I will be looking at how ecological and conservation terms have been used over time and how this provides privileges to certain groups in regards to conservation programmes, specifically the position in which it has placed scientific thought.

There have been many attempts to resolve environmental issues within Africa that affect land, water and animals. Most of the proposed solutions to these environmental problems have been heavily influenced by European ideas and initiatives both during colonialism and in the post-colonial era. Solutions from America and Europe have been applied, often with no regard to their suitability to the unique environment and the people who reside there. These interventions have been applied by colonial governments seeking to maintain control of territory as well as by international conservation organisations which rely on foreign support and donors. This section will explore how conservation programmes in Africa have changed, specifically regarding the ways in which protected reserves are used. It will also cover the interaction between local people and conservation, looking specifically at conflict that may occur when there are differences in opinion on the purpose of conservation. Finally it will focus on the specific context of Nigeria and the unique difficulties that face conservation efforts there. There are many different ways to solve environmental problems and the type of conservation programme used is a result of a network of actors, each with their own opinions and intentions.

Conservation policy can be designed around a number of different goals. These include protection of individual species, usually those who are viewed as in danger of extinction, protection of a habitat, usually linked to dwindling land quality or animal numbers, and finally the management of groups of ecosystems (Orlove and Brush, 1996:331). Policies in Africa have focused to varying degrees on all three; from anti-hunting policies to protect wildlife[2], grazing restrictions to prevent soil erosion[3] and the establishment of national parks[4]. As well as taking into the account the goal of the conservation effort, conservation programmes are also heavily influenced by the way in which humans are viewed in relation to the object of conservation. When conservation policy is built on the ideology that people are bad for natural resources, policies are put in place that exclude people from places that are

[2] Bans on hunting in Kenya that involved a shoot-to-kill policy for poachers. PELUSO, N. 1993. Coercing conservation: The politics of state resource control. *In:* LIPSCHUTZ, R. D. & CONCA, L. (eds.) *The State and Social Power in Global Environmental Politics.* New York, NY: Columbia University Press, ibid.

[3] Removal of pastoralists in eastern and southern Africa from conservation areas. BOLLIG, M. & SCHULTE, A. 1999. Environmental Change and Pastoral Perceptions: Degradation and Indigenous Knowledge in Two African Pastoral Communities. *Human Ecology,* 27**,** 493-514.

[4] Formation of the Central Kalahari Game Reserve in Botswana, which involved the removal of the indigenous Bushmen. HITCHCOCK, R. K. 1995. Centralization, Resource Depletion, and Coercive Conservation among the Tyua of the Northeastern Kalahari. Ibid.23**,** 169-198.

deemed to be endangered by their actions. This includes removal of pastoralists, farmers and hunters when they are seen to be causing damage. These ideologies can be influenced by politics, racial policy, economics as well as scientific and social theories. While conservation programmes continue to be implemented throughout the African continent, over time, as circumstance and ideology have shifted they have changed.

Changes in Conservation Theory

Milton (1997) outlines how anthropological theory surrounding the relation between people and their environment has changed over time. The knowledge produced by environmental study has varied over time based on the theoretical stances of its practitioners. Early models were deterministic, to be replaced by relativism and more recently theories that sought to remove the dichotomies between mind and body, thought and action and culture and nature. Originally human society and culture were explained in a deterministic way that fitted with Darwinian theory, as being products of the pressures produced by the environments in which they developed (pp. 477). As more ethnographies were produced that showed great variation in culture between ecologically similar areas this strict determinism became less useful as a theory. 'Cultural ecology' (cf. Julian Steward) and 'cultural materialism' (cf. Marvin Harris) followed, each retaining some features of determinism. The first stated that 'specific environmental factors shape particular cultural features' instead of viewing culture as a whole controlled entirely by the environment. The technology used to make use of environmental resources became a central point of study to determine how cultural practices emerged from the influence of the environment. The second, cultural materialism, attempted to demonstrate that all cultural features could be traced back to adaptation to environmental factors (Harris et al., 1966). Determinism became less popular in the 1960s and 1970s as maladaptive cultural practices were documented (Milton, 1997:480), undermining the basis of the theories, while causal explanations were also falling out of favour in anthropology. Ecological anthropology then split into two approaches, the ecosystem approach and ethnoecology (Kottak, 1999; Orlove, 1980). The ecosystem approach studied human influence on their environment as well as the environment's influence on humans and considered humans only a small part of what needed to be studied. Ethnoecology focused on environmental knowledge that is contained and understood only within a particular cultural context, looking at the ways in which different people conceived of the world (Kottak, 1999:26). In the 1990s theory was heavily influenced by two trends, one against cultural relativism and the other against the

modernist dichotomies between body and mind, action and thought and nature and culture (Headland, 1997). The second trend extends to discussions of Western Scientific thought in general and I address it in chapter two. It has been suggested that divisions between nature and culture in thought can alter patterns of environmental use, making it an area of important focus for anthropologists (Ingold, 1994; Dwyer, 1996). Changes in social theory are important as conservation programmes are often influenced by the social sciences of the time. Culture, environment and the interplay between the two are major driving forces behind the programmes and how they are implemented.

The Changing Status of Wildlife and Human Populations

Conservation programmes developed throughout the world both in direct response to major ecological events and as an attempt to prevent future extinctions of species or specific habitats. Knowledge and ecological policy travelled with colonists, especially those from Europe, as they spread across the globe. This was especially true in Africa where colonial governments began to develop conservation policy to tackle environmental problems they saw developing. Conservation policy involves the control of both animal and human populations in an effort to conserve an aspect of nature.

Colonial governments manipulated both animals and humans to serve both their political goals and how they saw nature in Africa. The ways in which wild animals were described by colonial governments changed as their political and economic position changed. European settlers originally used wildlife for both their own livelihoods and to improve relations with the African inhabitants. Animals were hunted for food and skins, which were sold or used to encourage local people to accept the colonial presence. As the colonies became more successful and were not reliant on game to maintain themselves or their local control, restrictions were placed on wildlife to preserve it for the rich to hunt for sport (MacKenzie, 1988:298). Hunting of animals changed from typical activity of the masses to an activity that was only possible for a select few. Wild animals changed from a vital part of the food supply, an economic and political tool, to a source of entertainment for those who could afford it. In the East Africa Protectorate (now Kenya) at the turn of the 20th century a licensing system was instituted to control hunting. Only Europeans who paid for a license could hunt wild game or use and sell them, special provisions were made for native people only if they were reliant on the meat to survive (East Africa Game Ordinance, 1906). Instead of relying on wild

animals for food, governments encouraged the farming of livestock. In many cases these were the same animals that had previously been hunted. Rather than using imported livestock, native wildlife was seen as an alternative that would be less damaging to the land and provide higher yields on poorer quality land (Beinart and Hughes, 2007:212). Game farming became popular in South Africa as a way to reduce stress on the environment. As native game animals had hooves that were better suited to the land than imported cows and other livestock, those who considered livestock to be a cause of soil erosion determined they were less destructive (Beinart, 2003:387). Although using native wildlife was seen as more ecologically responsible than farming imported livestock, it soon became viewed as a problem. Over-grazing from intensive farming and the damage it does to soil and plants became of increasing interest to conservationists. Protection of land and the habitats of animals that had not been farmed became of more interest. At the same time commercial hunting and tourism became more lucrative as opportunities for economic growth as independent African countries attempted to attract international investment. The concept of Africa as wild and untouched nature remained strong in the minds of Europeans and it is this picture that influences international conservation programmes, making wild animals in their native habitats again an economic tool, although this time it focuses on them alive rather than as meat.

As well as a changing role for wild animals, the relation between humans and the land has been presented by conservationists in various ways throughout African history. The early conservationist concern in colonial South Africa included long-term agricultural production through protection and enhancement of natural resources. As well as a changing role for wild animals, the relation between humans and the land has been presented by conservationists in various ways throughout African history. The early conservationist concern in colonial South Africa included long-term agricultural production through protection and enhancement of natural resources. The drought of 1933 in the midlands, that decimated sheep stock led to an increased awareness of the damage that was being done by soil erosion (Beinart, 2003:367). This was blamed by government commissions of the time on an intensification of farming and grazing by both white farmers and rural African communal areas. As humans expanded where they lived and worked large numbers of farmed native animals were seen as dangerous to their own habitat. At the same time populations were increasing, making land more valuable. There was more emphasis placed on the ecological damage that farmers and pastoralists were doing to the landscape. Colonial governments worked to protect the natural

environment from settlers and indigenous peoples with limited success. The argument has been put forward that the ecological element of environmental protection may hide the aspects that are attempts to exert control by governments over the human population (Beinart, 2000:273). Emphasising the importance of conservation allowed governments to keep wildlife available for colonial hunting, to justify land acquisition and in the case of South Africa, to prevent more Africans from leaving rural areas. There was recognition by some conservators involved in the development of policy that European settlers could be just as dangerous to the environment as indigenous people, but regulation still tended to impact indigenous people most heavily and ultimately benefit white settlers. Humans and their misuse of resources have been blamed for soil erosion, degradation of rangelands, desertification, loss of forests and the destruction of wildlife (Chatty and Colchester, 2002:4). These are due to over-grazing, burning of forests for farming, poor irrigation and over-hunting. Current conservation in Africa focuses on the conservation of natural resources that are seen to be in danger from human action. Recently there has been increased awareness of the loss of forests, resources and biodiversity due to the efforts of international conservation groups, while simultaneously there has been an increase in usage of previously unexploited areas. Increased land usage has been caused by population pressures, poverty and limits on agricultural uses of certain areas or types of land that make it necessary for people to move to new lands in order to maintain their livelihoods (Montoya, 2002:21). The influence of humans has most often been presented as detrimental to an idealised version of nature, although exactly what nature should look like varies depending upon whose interests are being considered.

The relation between humans and the land has always been a political issue. Governments have attempted to control who uses land, and the ways in which they use it throughout history. Areas may be privatised, collective legal titles may be given to allow communities to engage in business with outside investors and state-controlled territory may be made available to investors. When an area is set aside for conservation or economic activity then the occupants may be allowed to stay, limited in movement and activity or completely removed (Brockington et al., 2008:32). For the Kruger National Park in South Africa the residents were evicted to protect animal populations, but some have subsequently returned. Uluru National Park in Australia is managed by indigenous groups in cooperation with the state. Protected areas in the UK contain private land but allow for access to walkers and seek to preserve the character of the landscape, one that has been heavily influenced by human

behaviour. Each management style is ultimately controlled by the government, but is heavily influenced by the needs and interests of local populations. Where wildlife parks are privatised in countries such as Zimbabwe and South Africa, it is often viewed that that allowing commercial wildlife reserves countermands the government's official commitment to reducing racially unequal land distribution (pp. 184). White land owners are allowed to take advantage of international tourism opportunities, contain wildlife for commercial hunting and maintain anti-poaching patrols. In such cases the land owners may be less interested in conservation than protecting their economic interests and political power. Reserves and game parks were one way in which the conservation of nature was combined with the control of human behaviour. When individual species are regarded as endangered, restrictions on people living with or hunting the species have in the past been seen as an effective solution, this is evident throughout Africa. Policies that restrict the access of people to land tend to be more restrictive on those with less political power.

Reserves and Parks

One conservation strategy that was intended to both protect wildlife from extinction and limit human destruction of the landscape was the introduction of reserves and game parks. Parks and protected areas appeared in America and Europe in the 19th century as either wilderness preserves or the protection of forest and water resources. The first national parks were created by the US as a way of controlling the settlement and development of the Western territories, something they found necessary after the large scale destruction of forests and rapid industrialisation of the Eastern country (O'Neill, 1996). A desire to protect natural resources was combined with economic interests, placing large areas of land in reserves made the land surrounding it more valuable as local populations increased. As well as controlling the value of land, it also allowed for governments to control who had access to the resources contained in the reserves. Throughout the world, protected areas were created through the pressure of rich patrons ostensibly to promote the health benefits of nature and to ensure the protection of natural beauty. The people who were removed from the reserves, and those who lost the economic benefits of the resources were more susceptible to the control of the government as they were moved closer to hospitals, schools and were at times made reliant on the government for food and other necessities that they had previously been providing for themselves. In places where the government was attempting to establish control over errant groups this was seen as a benefit for society as a whole. Forest and game reserves in Europe,

Asia and Africa are all antecedents of modern protected areas. They were used to preserve game for hunting and timber resources (Orlove and Brush, 1996:331) . Game parks within Africa and Asia were later seen as a way for Europeans to capture the rural ideal that had been lost in the heavily industrialised and urbanised Europe (MacKenzie, 1988:306). Protected areas limit environmental protection to small areas where the residents can be controlled or removed. They are forced to change their lifestyles for the good of the environment, while tourists who visit the parks are not forced to change theirs (Harper, 2002:227). Environmental policy is effectively able to inconvenience the smallest number of people possible, most of whom are not in a political or economic position to prevent the disruption. Forest and game reserves have changed over the years to include aspects of biodiversity, land and resource conservation and science research for a variety of reasons. Research in some areas has shown the ineffectiveness of parks for maintaining biodiversity, the environmental destruction that is caused by resettling people and has recognised the impact of long-term human use on what were believed to be pristine landscapes (O'Neill, 1996:527). As well as an idealised landscape, moving human populations to provide space for parks was also an opportunity to introduce conformity and modernisation to people who would otherwise have been isolated from the rest of the country. While the benefits of parks and reserves as a conservation strategy are debatable, they have had clear political effects on the human populations that they restrict and control.

A strategy of exclusion and control of natural resources is based around a specific context, one that may change over time and make it necessary to adjust previously implemented plans. Limitations are put on land use in national parks, but as populations increase it becomes necessary for more agriculture to take place, and more intensively (Galvin et al., 2002:39). This becomes more important as economic concerns of local people begin to conflict with maintenance of park policies. Another impediment on local economics is the implementation of laws that make it illegal for them to kill predators, or otherwise prevent wildlife from damaging their fields and livestock. Diseases carried by wildlife can also restrict livestock movement (pp. 52). Solutions to economic and environmental problems that involve expanding human land use will impact the local wildlife and cause additional environmental problems. As it is also unlikely that human populations will decrease to numbers that are better supported by areas that are under land-use restrictions decisions have to be made as to how to balance nature preservation with economic and other human concerns.

Major environmental problems like the dust bowl in the US in the 1930s which were known to have been caused inappropriate farming techniques and overgrazing were seen as a warning against allowing continued soil erosion in Africa. Directly linking the behaviour of farmers to the subsequent destruction of topsoil encouraged policies aimed at small farmers and justified ecological policies aimed at small groups of land users. Although the causes of erosion in each place were different, colonial governments directly transplanted Western technical solutions to environmental problems, ignoring local practices and situational differences (Pimbert and Pretty, 1995:5). Alternate solutions such as adopting local pastoral systems which vary with conditions, allowing them to better adapt and avoid becoming environmentally destructive, were generally overlooked (Bollig and Schulte, 1999; Pimbert and Pretty, 1995:7). Unexpected results of the conservation programmes as well as changes in the environment, politics and economies of countries involved can cause conservation strategies that made sense during their implementation to fail.

In European national parks there is some recognition of existing rights and established farming that allowed displaced residents to maintain their livelihoods and protection by the state, but these customary rights were not consistently applied in the colonies (Chatty and Colchester, 2002:3; O'Neill, 1996). Indigenous people who are removed from their land for conservation reasons find that their knowledge and environmental management systems, developed over generations, are ignored (Hitchcock, 1995:170; Pimbert and Pretty, 1995:2). Management is instead turned over to a series of outside experts who are seen to be the best hope for putting an end to environmental degradation. These experts are from places such as NGOs and international agencies, who are involved in the networks concerned with biodiversity conservation. Models of intervention developed in the West have been transferred to the developing world, in many cases the focus has been on the constructions created by networks of scientists and others with an interest in either using or protecting natural resources in Africa rather than local contexts. Local management and land-use practices have been generally overlooked as ways of supporting and protecting biodiversity, instead governments rely on experts in biology, ecology and zoology to put 'more scientific' ones into place. Management of colonial countries was given to government agencies rather than relying on local residents.

Both scientists and corporations were seen as knowing better than others how to best manage natural resources (Beinart and Hughes, 2007:269). Until some return to study and use

traditional environmental knowledge the use of experts in a variety of biological sciences was seen as the only way to design programmes that would control the actions of land users in order to maintain the productiveness of the land. One reason why scientists may be considered best able to run conservation programmes is the way in which they place themselves at the centre of the conservation network (Berglund and Anderson, 2004:4). Scientists provide clearly defined processes behind the regeneration of landscapes, animal behaviour and the relation between the two. As they control the knowledge and technology that relates to studying the process as they explain it, they become the only people who are able to properly design conservation programmes that take advantage of these natural biological processes. While native people may understand the process in a similar way, or in a different way that is scientific in its own way, as they are not contained with the scientific network it is more difficult for them to participate as experts. As scientific explanations are generally accepted by Western people as the most accurate available, it follows that colonial governments, and the governments that have taken over from them, would accept scientific solutions to environmental problems.

Scientific thinking has been used to help construct conservation strategies in colonial Africa since the formation of colonial governments[5].As science was considered by Europeans to be the most rational way to solve problems, it was used as a justification for the institution of a number of conservation programmes including; irrigation, those limiting hunting and the creation of national reserves. During the colonial era, the majority of these programs impacted Africans more strongly than European settlers as they limited food sources and access to common resources. Environmental problems that were caused by European colonisation, the increase in human population due to disease control, over-hunting and damage to soil due to both land clearing and the expansion of farming hoofed animals, were still considered to be solvable through the institution of European scientific ideas.

Some scientific practices have continued from the colonial period until the present, albeit in altered forms. In 1938 Lord Hailey commissioned an African Survey. It was designed to coordinate all the scientific research of the British Empire. The purpose was to explore how science could be better coordinated and used both for administration and the improvement of

[5] See Baber, Z. (1998) The Science of Empire: Scientific Knowledge, Civilization, and Colonial Rule in India. Delhi: Oxford University Press. for a discussion of how scientific thought and technology were brought to bear in India during British rule.

social welfare (Beinart and Hughes, 2007:210). The universal nature of science, such that it could be used from region to region, is relevant in the usefulness of the study. Such large ranging programmes continue for Africa as a whole. Frameworks such as the New Partnership for Africa's Development (NEPAD), designed at the African Union Summit in 2001, include science and technology and the environment as important areas for development and investment[6].

Scientific personnel worked with local populations, mostly British settlers, to tackle local concerns such as trypanosomiasis control and soil conservation during the colonial period (Beinart and Hughes, 2007:205). Post-colonial interactions are generally through NGOs during the implementation of government condoned environmental or social programs. The dominance of science and the use of experts continue in the environmental policy of newly independent African countries and those involved in the international economic markets. However conservation programmes are changing, and are now beginning to include more social and development components. Where before the economic benefits of conservation went to the government and corporate interests, there is more pressure now to provide some economic benefit to the people who live in the environmentally troubled areas.

Parks and reserves can be viewed as a demonstration of discrimination by governments (Berglund and Anderson, 2004). This discrimination occurs by limiting who is allowed onto areas of land, and for what purpose they are allowed to use it. Divisions are made by the government between people and what they are entitled to. Additionally the land that is protected is separated from its human history. To declare that humans need to be removed to conserve a piece of land is encouraging the myth of pristine nature, making people believe that there was no human impact on the area to get it to the condition that is considered natural and worth conserving. By ignoring the contributions of human residents to the construction of the landscape governments are then able to control resources for their own benefit.

As more African countries became independent participants in the world economy there developed a clash between environmentalism, the political and social concern with the depletion of natural resources and developmentalism, a cultural model shaped by the ideals of industrialism, progress and consumption (Kottak, 1999:26). Isolating resources within

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[6] http://www.un.org/africa/osaa/nepad.html

reserves in order conserve them made it more difficult for countries to technologically advance and to compete effectively with those countries that had industrialised earlier. Fully industrialised countries use trade protectionism and other strategies that make access to natural resources even more important to developing countries. Sustainable development programmes aim at culturally appropriate, ecologically sensitive, self-regenerating change that is sustainable in the long term. Conservation programmes are only effective if those affected by them do not feel that their needs are being sacrificed for the sake of an animal or plant that they may not consider to be of as much importance as the conservationists do (pp. 27). By explaining the importance of conservation in terms that the local populations can understand and at the same time compensating them for any losses that conservation brings to them, sustainable development aims to be more effective than earlier attempts by garnering more support from those who could sabotage the conservation attempts.

The move away from using reserves to protect nature and towards sustained use and the integration of people into conservation strategies occurred as the public, particularly that in rich Western countries, became more concerned with environmental effects on humans and began to pressure governments and conservation organisations (Oates, 1999:45). Community-based conservation was proposed as a way to conserve wildlife or biodiversity, and resources that had traditionally been protected via parks and protected areas. Participatory-development was also promoted as a way to protect natural resources such as water, soil or forests while economically aiding the humans who relied on them (Campbell and Vainio-Mattila, 2003:418). There is growing evidence that local people have positively influenced biodiversity in the past, and that habitats that are now viewed as being threatened by people have in the past supported larger human populations without suffering irreparable ecological damage (Pimbert and Pretty, 1995:2). As recognition grows of the dynamism of ecosystems, information is being collected on the impact of local people on their development and maintenance. This provides an understanding necessary to effectively manage the resources as they exist today (Chatty and Colchester, 2002:8). Mainstream narratives about conservation and development have been merging. Developmental organisations have increasingly incorporated environmental rhetoric into policy and conservation organisations have acknowledged the development needs of local people. Community-based conservation has become a dominant theme in NGO policy statements (Campbell and Vainio-Mattila, 2003:418). Community-based conservation has two objectives, to enhance biodiversity conservation and to provide incentives for local people to

conserve their environment. Local people who benefit from and take responsibility for conservation and will be more likely to support its long-term success. This seeks to resolve the issue that the costs of creating and maintaining a protected area fall most heavily on local populations, making them less likely to support the protected area (421). A form of community-based conservation has always been an important part of pastoral life, as the continued use of natural resources is vital for survival. By acknowledging this, programmes designed around traditional ideas and practices should be able to effectively maintain and conserve important aspects of nature. One immediate difficulty that presents itself is with such a programme is that modernisation and population increases have altered land use and interaction between people and wildlife so drastically that traditional ideas may no longer be viable solutions (Galvin et al., 2002:37). There are also those who argue that indigenous people are no more likely to protect the environment than outsiders. The destruction of animal populations by local populations has been documented in a number of countries. Increased populations and more involvement in world markets also decrease the likelihood that indigenous people would place conservation above their economic development (Oates, 1999:56).

Development models suffer with the difficulty of spreading benefits fairly and limiting future problems caused by competition for development funds. More recent conservation efforts have accepted that protected areas should be managed in a way that protects local livelihoods while still maintaining nature conservancy (Pimbert and Pretty, 1995:4). Soil erosion, pollution and deforestation outside a protected area can still affect wildlife in the park through toxic water, flooding or other means. Community-based conservation is based on the idea that giving local communities a stake in conserving local resources will make them more inclined to support conservation programmes and protect biodiversity (Galvin et al., 2002:36). This allows the extension of conservation from a small region of wildlife to a larger ecosystem. Some locally created methods of resource management may be ecologically superior to those used by non-indigenous people and some indigenous peoples may have conservation strategies tied into their cultural traditional. However these are generally sustainable only under conditions of low population density, abundant land and a limited market economy (Redford, 1991). Community-based conservation strategies may incorporate aspects of indigenous culture, both to encourage participation and take advantage of local knowledge, but in areas that have rapidly increasing populations, are reliant on modern machinery and methods for occupations such as farming and animal husbandry or are

extensively tied to global markets, programmes must address the additional difficulties that these situations add to conservation efforts.

Continuing Problems: Economics and Politics

Different ethnic, economic and political groups may have different goals regarding conservation policies. These include the maintenance of biodiversity or the sustaining of local livelihoods. Parts of these goals may coincide, allowing the groups to work together, but they may not be synchronous in the long-term (Brown and Rosendo, 2000:46). Differences in economic goals and political opinions can cause rifts between groups who are intent on conserving the same area.

The main source of government drive behind conservation programs is economics. In the 1940s and 1950s, indigenous peoples were often seen by colonial governments as impediments to both conservation and modernisation policies. By resettling native populations, governments were able to encourage development through easier administration and provision of essential services to the population (Chatty and Colchester, 2002:5). As well as serving modernisation, resettlement also made resources available for use by other groups. These include European settlers, other native groups and commercial interests. Since independence, federal governments are still concerned with modernisation, and economic stability of the region. Controlling natural resources allows the government to secure the future economic stability of the country, encourages foreign investment and gives the government the power to distribute access to the resources to serve their own purposes. With the power to make and enforce policy, the federal government of a country is in the best position to dictate which conservation strategy they want the country to follow. Indigenous and non-indigenous local people have a variety of interests in conservation policy. Local people use wild resources as a source of food, especially during times of scarcity, particularly prior to a harvest. They also provide a source of income when sold at market (Pimbert and Pretty, 1995:12). Preservation of land rights, culture and assuring continued economic stability can all be involved in attempts to involve people in conservation strategies and community participation rather than simply excluding them from conservation efforts.

Which conservation strategies are implemented affects how well a local group is able to maintain their livelihood and culture. The level of influence a local group has in changing conservation policy can drastically alter their ability to defend themselves from outside

influence. For example, after Tanzania gained its independence, the territory of the Maasai that had been partially protected by the colonial government was redistributed to people and enterprises that were seen as more economically productive. The Maasai lacked education and political integration, which left them unable to effectively resist government action (Hodgson, 2008:216). More recently the Maasai have been able to form more effective political groups, and have also been able to integrate with NGOs in order to garner additional support for their cause. Although local people can sabotage conservation policies they don't agree with, through false compliance, feigned ignorance, sabotage and other means (Scott, 1985:29), ultimately the government can punish or displace them to force compliance if it feels it necessary to do so.

NGO's interest in conservation is either based on their desire to support conservation for its own sake, or to preserve resources for the economic improvement of an area. They require the support of both local people and governments in order to produce successful programs (Brown & Rosendo, 2000:45). NGOs have been involved in conservation in Africa for decades, before most countries became independent. The International Union for Conservation of Nature (IUCN) was established in 1948 and the World Wildlife Fund (WWF) was established in 1961. NGOs often control both planning and funding of projects which limits the participation and responsibility for local people. (Brown & Rosendo, 2000:44) Foreign governments and corporations are interested in the ecology of Africa for economic reasons. Africa is rich in a variety of resources that foreign governments and companies are interested in preserving for future use. Mining, lumbar and the scientific possibilities of medicinal plants are all economic impetuses for NGO's supporting ecological conservation and biodiversity.

Areas with environmental problems are often the areas with the least means to deal with such problems. In locations where the global economy increases environmental pressure on areas surrounding protected areas, there is decreased biodiversity within the protected areas. These pressures may be caused by extraction of natural resources for international use or shifts in local economics and population centres in response to participation in global markets. Increasing demands on natural resources combined with increasing destruction and pollution caused by industrial production have influence within the protected area itself. Additionally, loss of access to resources within the protected area forces local people to use new resources. Environmental degradation outside of the protected areas is an unintended consequence of

isolating what is sometimes the most productive land in a region (Harper, 2002:228). National parks that are not specifically designed to follow migrating animals (such as elephant corridors in India, designed to link protected habitats in order to allow migration) do not protect animals once they leave the protected area. While outside the park the animals must compete with humans in conservation areas, which leads to conflict between agriculture and wildlife. Patterns of migration have to be carefully observed in order to make functional parks and appropriate use of the land (Pollock, 1974:128). Difficulties arise again when there are environmental shifts that force animals or people to move in order to get adequate food and water. Civil wars within Sub-Saharan Africa and increased numbers of refugees also pose problems for conservation projects as those involved are forced to kill wildlife for both meat and money[7](Beinart, 1999:10). The instability of some African governments prevents them from effecting conservation policy while there are more pressing issues to consider. Conservation is not necessarily an immediate concern to either governments or local people who are suffering from economic difficulties, political instability and other more immediate problems.

Regional Conservation Ethnography

Conservation, both before and after independence, has been a major issue throughout Africa, Nigeria being no exception. There are several major ecological problems in Nigeria that continue to the present. All of them have complicated causes and require equally complex solutions. Each environmental problem in Nigeria is made more difficult to solve by political and economic issues that impact the country.

The area now known as Nigeria was originally made up of several different states that were united by Britain, in some cases through destructive wars. Nigeria was a British protectorate between 1901 and 1960, at which time it gained its independence. After independence this led to several struggles for power and a civil war. From 1966-1979 and 1984-1999 Nigeria was under the control of a series of military leaders, until a return to democracy. Many conservation programmes began before independence, and those that exist today are influenced by the federal system of government that was required to establish a functional

[7] Wars in Angola and Mozambique led to the killing of elephants for their ivory. Civil conflict in Rwanda led to people inhabiting the reserves designed to protect rare mountain gorillas and the subsequent hunting of those gorillas for food.

democratic government. There are currently 36 states in Nigeria which vary widely in economic strength, natural resources, religion and dominant ethnic group. These distinctions between different areas of Nigeria can lead to competition for resources and differing ideas on the importance of individual environmental issues. Unifying varied groups within a large country that contains very different landscapes makes for a complicated national conservation plan.

The Ten-Year Development plan (1945-56) which was instituted before independence focused on three environmental issues; water, health and town and country planning. Post-independence development plans have also focused on the same three issues. These policies are generally urban-centred, social-infrastructure focused projects (Areola, 1987:280). Long-term solutions are less often used than those ecological projects with quick results, for both political and economic reasons. Nigeria's main ecological problems include; erosion, flooding, drought, desertification, oil pollution, non-biodegradable petrochemical products, industrial pollution and waste, municipal solid waste, loss of forest and loss of biodiversity (Adeyinka et al., 2005:4; Okeke, 2004:191).

Southeastern Nigeria, the area in which I conducted my field work, has highly erodible soils, high rainfall and a high population density. As population pressures increase, there is a greater need for intense cultivation, fewer opportunities to let land remain fallow and greater destruction of ground cover. This exposes the soil to the weather, leading to erosion (Ijioma and Agbaeze, 2004:8). Soil that is already susceptible to degradation is eroded more quickly, which further increases the intensity of cultivation needed to maintain the population. Increasing urbanisation and modernisation add to these difficulties. The rapid growth of urban areas puts pressure on agricultural land (Ogbazi, 2004:276). Additional excavation is conducted for construction materials necessary for urban expansion, leading to increased erosion. (pp. 278) Drainage and waste disposal are not always adequate in urban areas. More dumps are needed for increasing solid waste and they provide a breeding ground for disease and threaten water quality. Burning refuse to deal with the additional waste also causes damage through air pollution (Ogbazi, 2004:280; Okeke, 2004:191). This is aggravated by refugees from other African countries, including Sierra Leone, DRC and Liberia, fleeing famine, drought, poverty and wars who increase the urban populations, and the pollution and toxic waste produced by corporations (Okeke, 2004:190; UN News Service, 2011). The variety of environmental problems are exacerbated by large human populations.

In Nigeria, land reforms have been seen as the best way to prevent abuse and misuse of land resources. The goals of the reforms are to control use of the land and resources to achieve sustained economic growth and to promote the well-being of the people (Areola, 1987:277). Government environmental programs include the Federal Environmental Protection Agency (FEPA) which was created after the discovery of a toxic waste dump and the National Council on Environment (Okeke, 2004:189). Conservation efforts have most often been responses to specific crises rather than long-term solutions. This has led to political responses being piecemeal and often indirect (Areola, 1987:279).

Forest policy has been more successful, the colonial government encouraged conservation of land and resources and this has continued since independence. The formation of protected areas allowed for the maintenance of future yields of forest products. These include lumbar, food and medicinal plants. Some of these would be taken directly from the forest, others, especially medicinal plants, could be taken in small amounts and grown elsewhere when their usefulness has been established by the business sector. Whether these would be domestic or international trades is something that would be determined by the level of interest and government participation. Protection policies are in place to maintain the possibility of future use, without necessarily providing a specific plan for which products would be used and in which markets. However, as the areas outside the reserves are overused, resources are eroded and population pressures expand, pressure builds on governments to allow more access to the reserves (Areola, 1987:281).

Governments are concerned with the preservation of resources for the future, which can often conflict with the immediate needs of expanding populations. This is especially relevant in a country such as Nigeria which has a rapidly increasing population and limited infrastructure available for the transportation of resources such as food. Outside of large cities the roads are in extremely poor condition and storage capability is limited due to the unreliability of electricity throughout the country. On a national level, only a small percentage of land is set aside for protection and it is generally done in areas with limited local populations, which is seen to limit the impact of protection on people (Oates, 1999:238). The benefits to the nation as a whole are seen as more important than a local few. The national government has instituted legislation that allows the government to claim land for public purpose and for development planning which gives it the power to enact environmental policy (Okeke,

2004:195). Nationally based governments can be in conflict with locally based groups due to conflicting interests.

Nigeria's federal system of government has also led to problems in a cohesive forest reserve program. Under the colonial system, power was shared between local and colonial authorities. Since independence, power over conservation has been shared between regional and federal authorities. All government agencies responsible for environmental management are organised hierarchically from federal to state to local levels (Okeke, 2004:197). Funding is provided partly by the government, but also by agreements with international agencies, both financial and development organisations (pp. 200). There is no history of a countrywide policy, and it is unlikely to emerge in the future until different states can agree (Areola, 1987:282). In order for conservation programs to be effective, they cannot rely on international agencies or NGOs, they require that the national government be primarily responsible for the construction and support of conservation within the country. The production of long-term programs is unlikely while there are economic and political issues more pressing to the government than those of ecological conservation (pp. 289). In addition, the state system in Nigeria means that when money is given to a particular area, whether for conservation or another reason, it is seen as favouritism and the other states demand additional resources as well. There are more than 250 ethnic groups within Nigeria, who have never been fully united into one nation. Creating multiple states that allow different groups to have some semblance of self-governance is seen by some as a way to unite the country together and help form a nation (Alapiki, 2005:50). However the result of this is competition between states becomes competition between ethnic groups. Without significant political unity at the national level, rather than the current state interests, one cohesive policy cannot appear. Additionally, the North/South divide in Nigeria causes political division. This divide has been evident since the formation of Nigeria, when in 1914 Britain united the separately administrated North and South protectorates (pp. 52). The strong economy of the resource-rich South has been used to support the desert North. Ethnic and religious divides remain strong between the North and South. The mainly Islamic North is dominated by the Hausa and Fulani, and the mostly Christian South has the majority groups of the Yoruba and Ibo. Political turmoil continues regarding which half of the country controls the presidency at which time and the distribution of oil revenues. Government funding and support of environmental issues should become stronger when the political situation stabilises (Okeke, 2004:202).

Any environmental program in Nigeria has to be compatible with both the federal system of governance and the needs of an urbanising country. Additionally, in order for programs to work they must be supported by a wide variety of people. If NGOs and foreign governments see a reason for investment, federal and local governments agree that the purpose behind the program is beneficial to the country and the region and finally, local people support the program then it will be possible for it to be effectively enacted over the long term. If government and NGOs can be satisfied that the benefits of an environmental program outweigh the costs of not enacting it then they must find a way to present this to local people or without constant harsh enforcement, which is difficult in geographical isolated regions, it will not be possible to maintain environmental programmes. Global benefits may not be reason enough to suffer local hardships. Programs need to be presented in such a way that there is incentive for local people to become involved, or at the very least, to dissuade them from sabotaging it.

The Mambila Plateau

Map 1: Location of Ngel Nyaki reserve.

As Nigeria is so diverse it is necessary to locate my research within a particular location and groups of people in order to bring to light the specific difficulties within the region. Ngel Nyaki is located on the Mambila Plateau in Taraba state. In this section I provide ethnographic information about the two main ethnic groups on the plateau, the Mambila and Fulani, and then describe the main conflict that occurs between the two groups. This will establish some context for political and economic issues that surround the forest reserve and field station.

The Mambila are believed to have been the first settlers on the previously uninhabited Mambila Plateau (Blench, 1988; Moyo, 2008). Linguistic differences suggest it may have occurred earlier, but archaeological and written historical records are in short supply. Fulani herders arrived on the Plateau not too long before European colonialism (Blench, 1988:36). Conquering the Banyo in present-day Cameroon sometime after 1835 gave them a base for raiding parties to enter the plateau. Herault (1998) gives a timeline of the progression of continued occupation. In 1902, the Germans invaded the plateau and by 1908 they permanently occupied it. This ended Fulani attacks, but Fulani and other groups continued to arrive, taking advantage of the good pastoral and farming conditions. Although the land was of good quality, the area was isolated and lacked roads and access to regional markets. Settlement of the plateau continued as the Nigerian administration encouraged repopulation and cattle breeding in the area in 1920. An administration centre was set up in the 1930s, which allowed for additional population as the area became less isolated. This was continued as major infrastructural developments were implemented from the 1950s onward. While there are many other ethnic groups present including the Ndola, Banso and Kamba, currently the two largest ethnic groups in on the Mambila Plateau are the Mambila and the Fulani (Frantz, 1981). The extensive history of conflict between the two; due to land disputes, politics and cultural differences, makes understanding the two groups and their interactions important to any project in the area. Understanding local ethnic conflict is especially important for one such as the NMFP that has an influence on who has rights to access and use land.

The Mambila

100,000 Mambila are estimated to live in Nigeria and Cameroon (Zeitlyn and Bagg, 2000:424). This is a large decrease from its height before the Fulani conquest of the plateau when the population is estimated to have reached one million (Herault, 1998:289). The Mambila people live on the Nigeria-Cameroon border, with the majority living on the

Mambila Plateau in Nigeria (Zeitlyn, 1993:223). There is a dearth of ethnographic information available on the Nigerian Mambila people. Recent information that is available generally focuses on the Mambila people on the Cameroon side of the Plateau and is concerned with linguistics and religion. Migration into Cameroon from Nigeria occurs due to land pressures caused by land registration changes, overgrazing and increased competition between farmers and graziers for land (Zeitlyn and Bagg, 2000:432).

The Mambila are believed to have come from north-eastern Africa. Oral traditions say they split from the Vute of Banyo (Southern Bantoid speakers from the Southwestern Adamawa region of Cameroon), but the time of this split is unknown. Although Mambila groups still speak their own language, they also use Fulfulde as a trade language and many also understand English (Ahmed, 1992). They speak a Bantoid language consistent with their roots among the Vute. Traditionally the separation from the Vute is thought to be as late as the 18th century, but according to Blench (1988:36) the linguistic distinctiveness of Mambila suggests they initially split much earlier. He also notes that among individual Mambila groups there is linguistic differentiation into non-mutably intelligible dialects caused by the isolation of clans during Fulani conquest.

Nigerian Mambila villages are organised on gerontocratic principles and lack well developed political offices. According to Zeitlyn (1993:223), exchange marriage has disappeared but bridewealth payment is still present. This may be only true among Cameroonian Mambila as Ahmed (1992) noted the practices of both exchange and brideprice in Nigeria. Within Yelwa only the bridewealth payment was common practice. According to Ahmed, during exchange marriages two families or clans exchange their daughters as wives for their sons. After such a marriage, only the wife and sons from the marriage have the right to inherit from their husband and father. Polygamy is common, as is divorce. If a woman leaves without producing a child, she has to pay back everything her husband spent on her before remarrying. Although traditional religion is losing some influence, Ahmed (1992) emphasises its continued relevance in Mambila society. Local governance is highly influenced by religion, the people are governed by priests whose laws come from the gods. The clan elders choose the chief from among the men of the royal family, and he then works together closely with a traditional priest. According to traditional religion, some forests, trees, shrubs and animals are sacred. No stranger or unauthorized people such as women and children are allowed to enter the sacred forests. If these things remain sacrosanct today then they may

need to be considered for their impact on forest and land use policies. Neither Islam nor Christianity has had a significant level of adherents among the Mambila according to Ahmed, but Frantz (1981) noted high levels of conversion to both when he visited in the 1970s. This could be due to the appearance of conversion in order to gain material benefits such as schools and political power, which may be less relevant since independence. Blench (1984) mentions the influence of Christian pastors among the Mambila, and a lack of Islamic conversion. This appears to be because of the negative association of Islam with the Fulani and a lack of desire to change traditional aspects of culture. Whatever the levels of conversion, there is definite cultural influence of both religions due to the political dominance of Muslims and the involvement of Christian missions in education. This is evidenced in a small way by the naming of Mambila children. They are given at least three names; one to be used by kin on the father's side, one used by kin on the mother's side and usually one from the Christian or Muslim faith. This is in addition to abbreviated and honorific nicknames (Zeitlyn and Bagg, 2000:429). Within Yelwa there was one hundred percent conversion of the Mambila to Islam. There are very few practitioners of traditional religions in the immediate region, and those who immigrate to the area convert to Islam upon arrival. This is probably related to the location of the village in the Islamic North of Nigeria and the political dominance of Muslims locally. During interactions with members of the field station the Mambila are all known by Islamic names.

The entire history of relations between Mambila and the Fulani is not clearly known. Skirmishes between the two groups occurred when the Banyo Fulani began slave raids and conquests into Mambila territory at the end of the 19th century (Blench, 1994). As Mambila at the time lived in scattered settlements and each hamlet was surrounded by a defensive forest that was several dozen metres thick, they were protected somewhat from the invading Fulani (Herault, 1998:290). Rehfisch's (1953) informants in the 1950s claimed that Mambila villages never became subordinate to the Fulani, and that trouble between the two groups was less before European conquest. However, significant depopulation had occurred due to the war. Mambila-Fulani relations continue to be poor due to political and land issues.

The Fulani

There is significantly more information available on the Fulani than the Mambila as those who live on the plateau are part of a much larger ethnic group that live across West Africa. The Fulani combine with the Hausa to make one of the three dominant groups in Nigeria

(along with the Yoruba and Igbo). Fulfulde is now the lingua franca along the Northern edge Nigeria-Cameroon border, spoken both by Fulani pastoralists and as a second language by others (Blench, 2003:4). Fulani is a collective term for a culturally, linguistically and politically related group of followers of Islam who inhabit West Africa. They are known as Fulani, Fulbe, Peul, Haalpulaar and Fellata among other names. Their traditional occupation has been cattle herding, which is now often combined with cultivation. As well as cattle, herds contain sheep, goats, donkeys and camels, although these are less culturally important and are dropped from the herds as the pastoralists move into more humid regions where they become susceptible to diseases (Blench, 1994). The classical base of their pastoral subsistence was the exchange of milk and dairy products for cereal, but more recently these products have been sold at market and then the money has been used for the purchase of staples and necessities. As women have traditionally been in charge of milk and milk products, while men are in charge of the livestock themselves, the income gained from these sales is at the women's disposal. Fulani are popularly seen as nomadic pastoralists who move according to rainfall (de Bruijn and van Dijk, 2003:288). The Fulani have spread through West Africa through both military conquest and pastoral nomadism (Blench, 1988:19).

Blench (1994) provides a history of Fulani movement through Nigeria and the expansion of pastoralism Southwards and across the Mambila plateau. This began when the Fulani arrived in the far north of Nigeria between the 14th and 16th centuries. Southern expansion was significantly hindered, there are debates about the reasons for this. One likely impediment is disease, specifically trypanosomiasis. Spread by the tsetse fly, this disease would have significantly reduced the numbers of zebu cattle owned by the Fulani. Eventually this would be overcome by the reduction of wild animals carrying the disease as the use of firearms spread, interbreeding with trypanotolerant cattle from other parts of Africa and the use of modern medicines. With the lack of Southern expansion opportunities, an urban, sedentary class that contained a significant number of religious scholars was able to establish itself in Northern Nigeria by the 19th century. This group built an extremely effective military that was able to successfully conquer a large number of nearby peoples, including the Hausa kingdoms. Military and political domination, combined with greater control over disease, allowed for the southward movement of pastoralists. Fulani groups also colonised Cameroon, and it was these people who moved at the end of the 19th century onto the Mambila plateau. Fulani colonisation of the plateau continued during the European colonial era as pastoralists

were well-protected by the Native Authority. After independence, increasing populations and land pressures caused the pastoralists to continue their southern movements.

The Fulani society is highly fragmented and diversified. Although large numbers of Fulani are cattle pastoralists, and it remains important to the cultural values of the group as a whole, there are a significant number of non-herders. There is a differentiation between pastoral Fulani, Fulani na'I, and urban Fulani, Fulani wuro (Blench, 1994). Urban Fulani that settled in cities were influenced by the people that they had conquered, and many stopped speaking Fulfulde. Although they may consider themselves ethnically Fulani, many in the urban North speak only Hausa and have nothing to do with cattle herding (Blench, 2003). Rather, they link themselves to the Fulani scholars and warriors of the 19th century in order to remain distinct from the Hausa. However, both urban and pastoral Fulani maintain a common identity based on cattle, behaviour and religion (de Bruijn and van Dijk, 2003:306).

An important part of Fulani identity is remaining separate from other group, as is explained by VerEecke (1994:30). Freedom (ndimaaku) is one of the core components of being Fulani. They identify themselves as being unique, and distinct from the groups that in the past they were able to conquer and enslave. In addition to being unlike other groups because they never gave up their freedom, another important cultural emphasis is on an elaborate sense of shame (semteende) which they consider non-Fulani to be lacking. They attempt to be free from needs, emotions and natural bodily functions including eating and toileting. In order to maintain their position of distinction and superiority, Fulani attempt to maintain physical and social distance from non-Fulani and generally practice endogamy.

The Fulani who reside on the Mambila Plateau are settled pastoralists. They are socially and physically separated from the Mambila, usually occupying separate villages, but the Fulani maintain significant political and economic power over the region. Surrounding Yelwa are several compounds where the majority of the Fulani live, although there are some who reside in the village itself. They do remain the richest and most politically powerful group in the area. There has been significant conflict between the two groups for a variety of reasons, beginning before European colonisation, and continuing until the present.

Agro-pastoralist conflict

Between January 1st and 7th 2002, over 50 herdsmen and a significant number of cattle were killed on the Mambila plateau, causing thousands of Fulani herders to flee Taraba state and enter Cameroon (afrol News, 2002; BBC, 2002; Misanet.com et al., 2002). There were various reasons stated for the outbreak of violence; The Miyetti Alla Cattle Breeders Association of Nigeria blamed a Mambila militia group said to be working with the backing of local politicians, officials from the local government accused Fulani herdsmen of bringing mercenaries from other countries to launch attacks on the local farmers, and local politicians have been blamed for using land issues as a way to win votes and compounding the problem. The majority of those herders who fled remained in Cameroon as refugees necessitating governmental intervention from both Cameroon and Nigeria (IRIN, 2005). In addition to Fulani fleeing to Cameroon, entire Mambila communities have also fled there to escape violence and disorder on the plateau (Blench, 1984).

There is a long history of conflict between herders and farmers on the plateau, and no effective solution has been found. During colonial times Rehfisch (1953) noted the oppression of Mambila farmers by the local Fulani. The Mambila felt that in the past, cases of damage perpetrated by cattle that had been taken to the courts were never dealt with fairly. The Fulani judges had thrown out the cases, allowed such a small amount of damages that it was not worthwhile going to court, or the plaintiff was found guilty of a false accusation and sentenced to prison, fined or whipped. Rehfisch found that the Mambila were oppressed and helpless to fight back against pastoral Fulani due to the latter's influence over the Native Administration. After independence, power was retained by the Fulani pastoralists, who dispossessed the Mambila of much of their land (Herault, 1998:292; Blench, 1988:22). However, Pastoralists have also been affected by changing land use. The establishment of Game Reserves and the enforcement of national frontiers have limited their ability to allow their herds to migrate throughout the seasons (Blench, 1988:23).

Gausset (2005) argues that although conflicts between agriculturalists and pastoralists may in some cases be a result of competition over scarce land resources, they are also influenced by social, political and historical factors. He conducted fieldwork on the Tikar plain, which borders the Mambila plateau. Unlike the plateau, it has a low population density, so agricultural-pastoral conflicts can be looked at without the influence of land pressures. The conflicts that Gausset identifies between agriculturalists and pastoralists include; different

perceptions as to what resources are to be used for, differing systems of management for the each groups, political issues surrounding competing legitimate claims to leadership and dispute settlement in an area. A lack of integration between pastoralists and farmers, especially due to the groups accepting the authority of different bodies, increases the chances of violence between the two groups. It becomes more difficult to come to agreements that both sides believe are just if power structures are corrupt or biased toward one side, and this can lead to people behaving aggressively in order to get what they perceive to be justice.

On the Mambila plateau, occupational differences generally occur along ethnic lines. Moyo (2008) contends that this adds to the levels of inter-ethnic conflict. Mambila are predominantly peasant farmers, the Fulani are pastoralists, while Banso and Kamba control commerce. Poor management of how land is distributed also influences inter-ethnic violence. There is increasing landlessness among marginalised Mambila peasant farmers compared to the more prosperous and commercially inclined other groups. In order to deal with conflicts over land Mambila generally first pursue court adjudication. Due to the nature of the court system, pastoralists are able to use their economic power to extend cases until the Mambila are no longer able to afford to continue or they can use it to bribe court officials. The Mambila use various strategies to overcome their economic difficulties; becoming tenant farmers, migrating to Cameroon, or by resisting incursions onto their land by richer groups. Mambila political leaders attempt to gain votes by promising to use their positions to redistribute land in a favourable way to the Mambila. Although agro-pastoral conflict explains some of the violence on the Mambila plateau, as there are clear issues concerning the distribution of land, there are other underlying reasons. Non-Fulani, including Mambila, own cattle as a reasonably secure investment (Blench, 1994). Fulani herders are hired to take care of the animals, both for local people and officials from further afield. Cattle are integrated into the local economy, and are important to more than just the Fulani. Outbreaks of violent conflict, although they may appear to be focused on land-use differences between pastoralists and farmers, are also heavily influenced by the imbalance of political power and the perceived unfairness of land distribution in the area.

Understanding the ethnic groups that reside on the Mambila plateau and how they relate to each other is important for the effective running of the NFMP. The NFMP interacts in different ways with each ethnic group. The village closest to the field station, Yelwa, is a Mambila village, and most of the staff that runs the station are from there. Two patrollers are

hired from each of the surrounding villages, both Fulani and Mambila, in an attempt to encourage more equal representation. By paying workers to work in the station, to do associated driving and other jobs and by helping with specific economic development programs, the project is changing the power balance between the villages as economic considerations are given to one group over another. This could lead to political difficulties as groups struggle to share in the economic benefits of being involved with the station. An additional possible cause of political difficulties is the isolation of land that forming a biological reserve causes. Cattle grazing on the reserve is still a problem for the project, despite the construction of fences and patrolling by guards. As these cattle are not necessarily owned by the people who herd them, but are often owned by rich and politically powerful people from other regions, limiting their ability to graze during times of hardship can have further reaching consequences than the local pastoralists. Religious convictions on the status of the forest, whether some people consider parts of it sacred and the presence of outsiders to be unacceptable must also be taken into consideration by the project. The stated aims of the NMFP include references to community and future local management of the forest. How the project defines 'community' need to be investigated, as the region is clearly not unified. If the local people are strongly divided then 'community' needs are going to vary greatly depending on who is being asked. In order to get to the ultimate goal of allowing local management of the forest, there would have to be agreement between those with who had a claim over the forest as to the purpose of the forest, the best use for the land, and who should have control over management. In a region with continuing violent conflict between ethnic groups this seems unlikely in the foreseeable future.

Conclusion

Both the anthropological study of the environment and conservation programmes themselves have been heavily influenced by science as scientific ideas become more centred within government and NGO planning and execution. The terms used often have a scientific basis (Darwinism, ecosystem) and are based around contemporary scientific ideas. Scientific practices that emerged in Europe have carried over to Africa where they continue to develop, influenced both by the international scientific community and the local contexts in which they are practised. This is true in the case of Ngel Nyaki where international scientific research is being practised in the specific social, political and economic contexts of the Mambila Plateau. In addition to this the research is also being influenced by the remnants of colonial conservation efforts which both affected the development of the forest reserve and

may colour the way in which the forest conservation project is viewed by local, national and international observers and participants.

This thesis looks at how the ideas and belief systems behind conservation affect how conservation is carried out. As the main impetus behind conservation at Ngel Nyaki is currently scientific research I will focus on how science is carried out and scientific knowledge is transmitted and transformed and how this relates to the process of conservation. The next chapter focuses on science studies, specifically on Actor-Network Theory. The divide between nature and culture and how it is defined is an important part of science studies that is very relevant when science is applied to conservation. Context is an important part of Actor-Network theory, so after the groundwork of science study theory has been established in the next chapter, the environmental and social contexts established in this chapter will again come into play.

Thesis Outline

Chapter 2 of this thesis discusses first of all science studies, specifically actor-network theory. Then it discusses the theory of scientific knowledge, how knowledge is formed and how it interacts with other forms of knowledge. This sets up the reasoning behind how I conducted my research and analysis.

Chapter 3 discusses the way in which three projects are conducted at the NMFP. Each project has a different structure, but has behind it a scientific paradigm. The way in which each is constructed affects the knowledge that they produce and the way that they construct the idea of the forest. Each project involves field assistants who are involved heavily in the collection of data and the creation of scientific knowledge.

Chapter 4 focuses more heavily on the field assistants and also introduces additional actants in the network, including an NGO. The different interests of these actants, and the ways in which they view the forest have an influence on the network and how it interacts with the local community. Issues that surround the forest reserve are discussed at the end of the chapter in relation to the different actants involved.

Chapter 5 brings together the conclusions drawn in the other chapters regarding the role of scientific knowledge on both the NMFP and the construction of conservation programmes. Additionally it also discusses the future of the reserve and possibilities for future research.

Chapter 2. Science and the Production of Knowledge

Conservation policy in Africa has been heavily affected by Western scientific thought, leading to the institution of a number of scientific environmental policies that were developed in Western countries. Current ecological conservation focuses on maintenance of biodiversity, the variety of ecosystems, species and genetics. Escobar (1998) argues that this has led to the formation of a variety of networks designed to support the transfer of knowledge, resources and materials and control the discourse surrounding conservation through the use of strategies, programmes and experts. These networks originate from science, capital and management. Scientific disciplines dominant biodiversity conservation as it involves monitoring and assessment, which are the mainstays of modern Western science.

Science has been present throughout the world in various forms of technical inventiveness, mathematics and investigation into natural phenomena. Many modern scientific fields have drawn from concepts developed by the ancient Egyptians, Chinese and Greeks among others. However there has been no scientific revolution that has been as influential as the one that took place in 17th century Europe. By establishing a strong focus on observation, experimentation and leading to the establishment of professional scientists, the scientific revolution established Western science as the dominant form of knowledge throughout European societies. As Europeans spread their influence throughout the world they took Western science with them.

Science is distinguished from non-science by its empirical and inductive method, which relies on experiments and observation (Popper, 1963a). Another import trait of science is that it is predictive. A scientific theory will predict what will be observed in certain conditions. If observations are not in line with what has been predicted then the theory is proven to be incorrect. The most important aspect of a scientific theory is its predictive power, as that is the only way to determine the validity of a theory or to assess the superiority of one theory over another. It is easy to obtain confirmations for theories throughout the world if they are looked for so a legitimate test of a theory is an attempt to refute it, not to prove it. Confirming evidence is only counted when it is a result of a serious attempt to refute the theory. Observations in science are always driven by hypothesis and theory, determining what needs to be observed. There are an unlimited number of things that can be observed and

experiments that can be run, but theory allows hypotheses to be developed and then guides what is observed.

Science Studies

The publication by Thomas Kuhn of *The Structure of Scientific Revolutions* (Kuhn, 1996, first published in 1962) challenged dominant views of science by focusing on the activities around scientific research. His ideas on science coincided with the emergence of the sociology of scientific knowledge (SSK) in the 1970s (Pickering, 1992:1). Two positions were at the centre of this approach. First, science is entirely social and therefore scientific knowledge must be seen as a social product. Second, SSK is empirical and naturalistic. In the beginning of science studies there were two main schools, Edinburgh and Bath. The Edinburgh school[8] was macrosocial, tracing causal connections between classical sociological variables and the content of the knowledge. The Bath school[9] was more microsocial, it looked at scientific controversies to demonstrate the production of knowledge as being the outcome of negotiations between scientific actors. In the late 1970s a number of other approaches began to emerge in SSK, including those of Latour (Latour and Woolgar, 1979) and Knorr-Cetina (1981; Knorr Cetina and Mulkay, 1983). They all refused to accept philosophical apriorism and were concerned with the social dimensions of science. SSK emphasises the instrumental aspect of scientific knowledge and the agency of scientific actors. Knowledge is for use and actors have their own interests that instruments can serve (Pickering, 1992:4). Scientific knowledge has to be seen not as a transparent representation of nature, but rather as knowledge relative to a particular culture, with this relativity specified through a sociological concept of interest.

Actor-Network Theory

Actor-Network theory identifies and traces networks to try and describe how scientific research progresses, to describe the people involved and the processes that take place in the formation of knowledge. It attempts to describe how and why scientific practice and knowledge have developed and in what ways they continue to develop by following actor-networks as they form, hold together or fold apart. Concepts that are central to ANT are

[8] Cf: Barry Barnes, David Bloor, Steven Shapin.

[9] Cf: Harry Collins.

representation, translation, actor-networks, the relationship between nature and society and a definition of actant that includes both humans and non-humans. Actor-Network theory is a material-semiotic method, in that it follows relations that are both between things and between concepts. ANT tries to explain the formation and behaviour of these networks. These networks are viewed as being never stable, and in a constant state of re-making as the various objects in the network interact, the network has to be constantly performed in order to maintain it.

Actants

Latour (1987:83) defines an actant as something or someone who is represented by a spokesman. This includes both humans and nonhumans who have interests that need to be accommodated, managed and can be used. Actants take the shape they do by virtue of the relations they are involved in within a network. In Latour's examples both micro-organisms whose behaviours were represented differently by Pasteur and Pouchet and the striking workers whose opinions on ending the strike were represented differently by their stop steward and a secret ballot are actants. All the components of the network are actants and are simultaneously semiotic and material.

In order to make a full account of science it is necessary to explore how nonhumans are represented. Nonhumans are brought into scientific discussions by scientists and they are not always viewed the same way by all scientists. There are various forms of the nonhuman, constructed through discussion and argument, and if they are not all mentioned in analysis then one point of view is raised above another. By treating both humans and nonhumans as actants a more unbiased and complete analysis can be given.

Translation

Latour (1987:108) defines translation as the interpretation given by the fact-builders of their interests and that of the people they enrol. Anyone who seeks to be a spokesman for the interests of actants must both enrol others in the construction of a fact, and also keep the actants behaviour under control and predictable. This is done through manipulation of interests and goals, making oneself indispensable to the network, maintaining key alliances and controlling the links between various actants.

Translation is not a neutral act, it works to change the interests of those involved. Translation is the way in which innovators attempt to form a network that will be built and then continually rebuilt by the actors within it. A problem is defined, actors are involved and if the translation is successful the actors support the network and it also receives support from those who are represented by the actors. Callon's (1986) article regarding the relationships between researchers, scallops and fishermen sought to study power through the viewpoint of translation. It attempts to provide a common frame of reference for the study of both nature and society. Both are linked together in a series of complex relationships that are renegotiated by a variety of actants. In this case the actants included such representatives of nature as the tide and scallops, as well as societal representatives scientific colleagues and fishermen. The scientists, who were working as spokesmen for both the fishermen and the scallops, tried to establish themselves as an obligatory point of passage in order to maintain their control over the network and solidify their place within it as they defined the problem in ways that supported their inclusion in the network. The article focused on four moments of translation, where researchers attempted to define the situation under study and centre themselves within it. Through descriptions of these translations it was possible to describe the process of translation and how it forms the natural and social worlds. In turn it describes the formation of power relationships, how small groups become representatives of larger more disparate groups and how these relationships serve to control the actors participating in them. Callon described an unsuccessful attempt at translation, but others (van der Sluijs et al., 1998) describe those who are able to translate successfully and maintain networks by adjusting information and relations between actors over time to keep the networks relevant.

Representation

There is not much difference between humans and nonhumans, they both need someone to talk for them (Latour, 1987:72). For people this might be because they form a group that cannot all be heard, or because they don't have the means to speak due to language or physical constraints. Actants can be represented by different spokesmen in different ways. Those who argue against the spokesman must look at the proof he provides that his representation is accurate as the actants themselves are unable to talk for themselves.

Representation of objects by mediators is an important concept in ANT. Many actors who in other theoretical stances are seen as not affecting the object under study become the focus of ANT studies. This applies to both non-human and human actors. Despret (2005) focuses on

representation, in this article the focus is on sheep and the ways in which people who study them have the power to alter the explanation of what it is to be a sheep. It explores how the conditions surrounding observation will affect the outcomes and the conclusions of the research. Things that are more interesting and more obvious to those in the scientific community will get more attention from researchers. Competition as an explanation for animal behaviour is over-emphasized because it is obvious and easy to explain and track. Predation of most species is not so easy to observe, it is less easy to see in natural conditions or recreate in experimental conditions, and it is also altered by the presence of the researcher. More complex, more interesting behaviours can be observed if the adaptation of animals to the presence of the researcher is taken into account and efforts are made to remove more simple explanations. Agency must be given to the object of study, by exploring a larger variety of aspects of a sheep's life and determining which are most relevant to the sheep themselves, it is possible to perceive behaviours that are more complex than what were seen in the past. Influences on the researchers such as funding, subject matter that is more likely to be published and widely held beliefs within the biological and animal behavioural academic communities affect the kinds of questions that are asked and the observations that are made. As the researchers have so much power as representatives, Despret argues it is necessary to look at why they research in the way they do, what are the forces and networks working upon them, otherwise the voice of the sheep will be lost under the voice of those who speak for them.

Data is a form of representation created by interaction with the natural world. It is then juxtaposed with other data to form new relationships which are manipulated to form higher-level representations that are more general and further from their objects. These operations can be seen as translations of representations into new forms that are more generally applicable. Universal scientific knowledge is the product of the manipulation of local accounts. It is only applicable through a new set of manipulations that adapt it to those local circumstances. Laboratories contain tools that create representations and test relationships.

Networks

> *"The word network indicates that resources are concentrated in a few places- the knots and the nodes- which are connected with one another - the links and the mesh: these connections transform the scattered resources into a net that may seem to extend everywhere."*
>
> *(Latour, 1987:180)*

Networks are the object of analysis in ANT. The observer attempts to trace the connections between actants and describe the actor-networks that have been created around a particular problem. Latour (1987) states the importance of remaining as objective as possible when following the networks in order to avoid limiting analysis to the opinion of one group. Whenever a divide appears in a network, both sides must be studied simultaneously and all those involved must be accounted for. This is intended to provide a comprehensive overview that will include actors that would be overlooked using other methodologies.

ANT can be used to describe a variety of networks, of different sizes, from a single laboratory (Latour and Woolgar, 1979) to an entire forest. These networks can extend in any number of directions. Circulating Reference, a chapter in Pandora's Hope (Latour, 1999) discusses the representation of a forest by different scientists and the relationships that these representations reveal. In fitting with the premise of the book that there is no gap between a cognitive subject and the objects of nature and technology in the outside world, the chapter follows objects and concepts as they are translated through networks, making the entire forest mobile. ANT has been used to study a large variety of sciences in a number of different contexts. It assumes that nothing lies outside the network of relations and suggests that there is no difference in the ability of technology, humans, animals, or other non-humans to act. As soon as an actor engages with an actor-network it too is caught up in the web of relations

Nature-Culture

In Western society there is an established distinction between nature and culture (Descola and Pálsson, 1996). Human beings are considered different from other forms of life and other objects in the world, with a unique view of the world and a separate culture. Nature is also conceived of as something universal, that can interact with culture, but which is distinct and non-human. Ellen (1996) argues that nature is a social concept that varies between groups. He outlines three aspects that in different amounts make up a group's definition of nature. The first is that nature is a series of things that are to be classified, named and inventoried by humans. This is a large part of the way that nature is defined by Western science. Biologists have constructed and reconstructed taxonomies for all life, chemists identify and name different elements and compounds and physicists have classified a variety of different forces and energies. Secondly, nature is a space which is not human; anything outside of the usual human dwelling area is considered nature. For scientists this ranges from the entire universe (and other universes) to the molecules and forces that make up matter. Finally, nature is a

force outside of human control, the spirit of nature or the mother Earth. This can be the laws of physics (including those of thermodynamics and motion), the functioning of genes or chemical laws (such as Avogadro's Law and the Ideal Gas Law). All three are part of how nature is defined, and the relation between the three varies contextually. Groups tend to have a general agreement on the meaning based on historical and linguistic relations, but individual views may still vary within the groups. Depending on their field of specialisation, scientists will have differing views on exactly what nature refers to, but as a group they consider it something that can be studied, explained and defined.

A separation between nature and culture may be conceptualised in different ways, or no separation may be acknowledged at all. In regards to Western science, nature is viewed as the object of examination. Scientists work to reveal how nature works. Everything from genetics to gravity is seen as nature. Experimental results are not regarded as a product of scientific culture, rather they are a reflection of the universal realities of nature. Culture and society are seen as being completely separate, no matter where a scientist comes from, if he is practising according to the scientific method then his results will be a reflection of nature, not of the culture he comes from.

The concepts of nature and culture have been used throughout anthropological theory in a variety of ways, looking at a variety of cultural aspects from widely different theoretical stances, however the dichotomy was taken for granted and an identical, universalistic conception of nature was shared by all (Descola & Pálsson, 1996: 3). Some of the arguments against assuming the dichotomy are that it objectifies local knowledge according to Western scientific standards meaning they can never be properly understood, it limits the ways in which biological knowledge develops by assuming a distinction between organisms and their environment rather than a reciprocal engagement and it ignores the possibility that non-human organisms may have their own culture that influences the 'natural' environment. It also has to be considered that not all societies recognise the nature-culture dichotomy, and modern scientific advancements blur the lines between what is natural and what is not, creating more discussions around the accuracy of the assumption of a nature-culture divide. It is also possible that even though a group claim that they make a clear distinction between nature and culture, it is not necessarily reflected in the way they act (Milton, 1997:487).

Accepting that this separation between nature and culture exists impacts the way in which a person views the world. The dichotomy of nature and culture removes people from the

relational matrix of their existence in the world and moves that world instead into their heads (Ingold, 1996:113). It implies that non-humans do not have a society, and live in a purely physical world. Non-humans become something that is observed by a human. The non-human is not separate from its environment, it is all part of something that can be described and experienced by a human observer. Only humans can disengage from nature and observe it, so only humans can be outside of nature. Although scientists have assigned a nature-culture divide and decide what competences can be provided by which actant, it is not necessary for those studying scientists to do the same.

If nonhumans are assigned a different position than humans then instead of following the actions of the scientists they are simply being replaced as the people who decide the divisions. To restrict study to the human side is to accept the divide between nature and society (Callon and Latour, 1992:352). All actants, nonhuman and human, are still not viewed as being the same, but the question of in which ways they are different or the same is left open.

Relevance of ANT

A central point of the justification for using ANT rather than other sociological theories to study science is the way in which the modern world is constructed and how it views science. Latour (Latour, 1990; Latour, 1993b) defines what he sees as the beginnings of the modern world. He focuses on the debates between Robert Boyle and Thomas Hobbes surrounding experiments with air-pumps in the 1660s as a point at which there was a distinct effort to create a demarcation between science and its context. This created, Latour argues, a divide between representation of things through the laboratory and the representation of people through the social contract that hadn't previously existed. Before this point there was no clear demarcation between politics and science, between culture and nature. However after this point there was a mostly unquestioned divide between the two, in the minds of Western peoples.

As this divide between nature and culture was artificially created (Latour, 1993b), there is a struggle when people attempt to use the modern way of thinking to attempt to explain societies-natures. Global warming, deforestation and the effect of genes on human behaviour are all partly explained by nature and partly by humans, the divide is no longer clear. ANT provides a different way of thinking (Latour, 1990), instead of explaining phenomena by a

mixture or combination of the two pure forms of nature and society it enrols and redifines actants. Nature and society are accounted for as the historical consequences of the movement of collective things, rather than being the explanation. Both nature and society are examined together to understand the role each plays, and how the final product of each is formed.

Science studies conducted under the assumption of a split between nature and social relations view the objects in a network differently. Traweek (1988) studied high energy physics using a Durkheimian theoretical stance that cosmological classifications are organised corresponding to the way we organise society. The detectors used to capture information about particles during experiments, which would have been viewed as an object with agency using ANT, were described instead as a material embodiment of the culture of high energy physics, a text to be read and created by scientists. Rather than creating society they were a reflection of it. This is in contradiction to the ANT position. Latour (1990) explains that particle physicists do not reflect their existing culture, a society that collides particles inside gigantic accelerators is not the same as one that does not (pp. 168). Nothnagel (1996), who also looked at high energy physics, discusses the use of nature as a producer of culture. Science is treated differently in Traweek's work than a non-scientific culture would be. Physics knowledge is not related to the social structure of the physics culture, as it would be were the knowledge something non-scientific such as cockfighting. Science is treated as separate and different from other cultural practises, whereas ANT traces science networks in the same way that any other networks would be traced, treating science as just another type of cultural practice.

Construction

The construction of scientific fact is a concern for ANT along with the nature-culture divide. In Laboratory Life (Latour and Woolgar, 1979:236), construction is defined as "the practical operations that transform a statement into an object or a fact into an artefact". Reality is a consequence of this construction. As different parts of the object or fact are supported or rejected an artefact is created that is transferable to other networks. The focus of ANT is the construction process, how a fact becomes an artefact. This is continued with the concept of an agonistic field (pp. 237). Reality is the consequence, rather than the cause, of the construction of facts. The agonistic field is the total of the operations that work to create the facts. Scientists' work is filled with various conflicts, including interaction with the agonistic field, and this is what guides their behaviour. Nature is created out of this behaviour, as are other

areas of society. This explains the disorder of scientific fields more effectively than saying scientists are being directed by a specific nature. Rather science is an attempt to create order out of disorder. Representations of nature by science are attempts by the scientists to find a pattern in the surrounding world.

The concept of a black box, a term cyberneticians use to describe a piece of machinery that is too complex to be understood, which obscures the process allowing only the input and output to be considered, is used as a descriptive-analytic term (Latour & Woolgar, 1979; Latour, 1987) as a way to remove the assumptions people may begin with when studying science and technology. He argues that science should be studied in action, so it may be studied before the facts and technologies involved have been placed into black boxes, as the techniques and machines are being created, or alternatively it may be studied after a controversy forces the re-examination or altered usage of a previous accepted scientific concept or technique. Along with when science should be studied, Latour also argues for the how science should be studied. The transformations that a concept or machinery undergoes as it moves through networks are more revealing than the technical, intrinsic qualities of the item or idea. Neither nature nor society can be used to explain the how a scientific controversy will be resolved because the resolution itself influences the representation of nature and the stability of society. Instead those who wish to study science should look at how human and non-humans are engaged to resolve the controversy. Additionally science studies should focus on the networks of everyone involved in the creation and use of technoscience, including non-human actors. Scientists and engineers are representatives of others in the network, who they use to increase the strength of their position within the network, giving their scientific action a better chance at success. Rather than facts and the scientific method being the dictators of what science is successful and adopted throughout society, Latour sees the strength of networks and how they compete with other networks as more important in the establishment of scientific fact.

Performance

An important concept in science studies is relational materiality, objects are defined by their places in networks, and their properties appear in the context of tests, not in isolation (Law, 1999). Following stem cell research in the UK Franklin (2005) revealed an extensive number of global connections and showed the multiplicity of identities that a scientific concept can hold. Stem cells have identities as scientific, corporate, national and public entities, within

which they are unstable and contested. As an imagined future they have an influence on scientific research, health priorities, commercial investment and technological innovation. The cell lines used are related to humans genetically, they may be used to cure human disease in the future and their use stirs significant political and moral debate. Franklin suggests "culturing up the culture medium" by thinking about how the culture concept travels from the stem cells back into society to challenge current models of biological scale, temporality and form.

Lien and Law (2011) also address the performative aspect of the nature-culture divide by arguing that the concept of salmon in Norway is constantly practised. Distinctions are made between salmon that would not exist without society. Categories such as farmed and wild, and how natural a specific salmon is are created by those who interact with the salmon, they are not explained if nature and society are viewed as completely separate. Salmon that are farmed are not considered natural when they are escape, even though they are within their natural range. By defining those fish that have been influenced by humans in direct ways as being different than natural, boundary practices are formed between nature and society. Boundary practices are set up in a variety of ways when people seek to define what is within a group and what is not. In this case a separation is placed between nature and culture, those fish affected by humans through farming are separate from those that are natural due to the influence of culture. Different practices will result in different variations in how objects are understood and a material-semiotic approach such as ANT is well-placed to begin understanding of why objects are defined as they are.

Law (2004) focuses on how the methods used in both the natural and social sciences need to be understood in order to properly interpret the results. He also sees current method to be under the control of these same ideas that did not exist before the 17th century, but which have persisted in European science studies. If science study method is viewed to be performative, as ANT suggests, the realities that it produce have political implications and are never purely technical. When the method used ignores the boundary that science has created between nature and culture then it is not possible to accurately describe the way in which science is practised. Law offers several suggestions for reordering method to overcome the modern bias. One main area of focus is to look at the process of research rather than focusing on only the product. Messy products are currently viewed to come from poor method, but Law argues that looking at the process could reveal that it is a messy reality

being revealed through good method. According to Law, method creates realities through a continuing process that creates boundaries between presence, manifest absence and Otherness. As a researcher looks at a subject they decide what is to be included, what is to be left out and what is so unrelated as to be of no interest whatsoever. These boundaries set up the framework for how the final reality is to be created. Looking at how and why these boundaries are set up, the process involved, Law argues is a more useful way to view science research, as it is able to include both politics and science rather than forcing a divide between them.

Criticisms

ANT has been subject to both criticism and modification. Star discusses (Star and Griesemer, 1989; Star, 1991) the importance of recognising heterogeneity within networks. Influenced by feminist theory she argues that it is common to overlook members of networks who are deemed less important and not enough attention is paid to how membership in multiple networks will influence actant behaviour. Tracing a network will be incomplete if membership in other networks is overlooked. Actants may be members of multiple networks, some of which may have conflicting interests. When the intersections and conflicts between networks are being examined in order to determine how a network has been stabilised, the resolution of conflict within individuals may be as important as cooperation between networks. As a possible adjustment to ANT, Star suggests that rather than funnelling the interests of multiple actors into a narrower passage point, a many-to-many mapping technique may be more effective. This increases the number of obligatory points of passage. Rather than a single scientist retaining control of the network, the influence and contributions of a larger number of actants will be acknowledged. Criticisms of ANT have suggested that it focuses to intently on one actant, creating an image of one dominant hero persona within the network, such as Louis Pasteur in Latour's work (1993a). Hine (2006) studied the networks surrounding a single genetic database. The suggestion that came from this work is that as networks become increasingly complex it is becoming necessary to develop novel ethnographic strategies in order to be able to effectively follow the networks. ANT can only remain an effective theory so long as the fieldwork can adequately cover the area of study.

There are a number of criticisms levelled against ANT. Providing agency to non-human objects is a place of argument, ANT is also considered by some to be so descriptive that it serves no useful purpose and explains nothing leaving no explanation of social processes

while also not providing an outside structure by which to judge the importance of actors in the network. Agency is given to non-humans, not implying that a scientific technique makes decisions about the direction it wants a network to go, but instead that non-humans are not simply passive, they do have an influence on those who interact with them. A study of the use and development of PCR techniques as a way of replicating small amounts of DNA (Jordan and Lynch, 1998) argued that the presence of PCR in the scientific network influences how work progresses, the choices that individual scientists and entire laboratories make, and by extension what sort of scientific knowledge is produced. Hess (2007) addresses the charge of pointless description by arguing that by understanding the complexities of interactions between groups, how they choose to represent situations in order to benefit their cause and how these are related to the broader historical context is a valuable way to understand others. This understanding then makes it more possible to adapt one's own behaviours to interact more effectively with the other, a valuable tool in increasingly global fields such as science. Frickel (1996) describes the confusion surrounding ANT accounts as lying partially in the ambiguous role played by "social context" and argues for the political and explanatory importance of resketching the boundaries between the laboratory and society. Over time conceptual distinctions among science, technology, and society, between people and things, and among historical periods have been constructed to appear "naturally" different and unequal. Societal power vested in science and technology, scientists, engineers and their labs are reflections of the same boundaries. Because politics and epistemology are intertwined when ANT tries to remove the categorical distinctions it is rejected as a reordering of society. However because society is rendered transparent by ANT, social explanations are no longer useful in providing explanation regarding the behaviour of actants, but instead are part of the question.

Actor-Network theory does add to the discussion of STS. By defining boundaries it allows examination of science and technology on the same basis that other cultures are examined, providing a way for an anthropological approach to be applied to the field of science in a way that has not been possible before. This improves comparisons of different types of science and different types of knowledge across the world, which aside from providing more accurate descriptions, it can also ease future science and technology globalisation by demonstrating how networks function and actants interact during the spreading of concepts and machines. Finally, removing the separation between nature and society provides more useful descriptions of relations in science that is situated within human societies but is attempting to

explain non-human action, as well as science that involves complex hybrids between society and nature. In order to apply science studies to the area of conservation, I will now explore the differences between local and scientific knowledge. I argue that knowledge is constructed, and that scientific knowledge production is guided by paradigms that scientists are working within.

Scientific Knowledge Construction

Knowledge is made up of the things a person uses to interpret and act on the world (Barth, 2002:1). These can include information, skills, feelings and all the other aspects of understanding that make up perceived realities. Knowledge varies within a society, as different people are given different information and are exposed to different ways of viewing the world. Barth (1990) compares two different ways of constructing knowledge in Bali and New Guinea in order to demonstrate that knowledge can serve many purposes in a society and can shape the society itself. In New Guinea he observed that the value of knowledge is enhanced by keeping it secret and only revealing it through specific ceremonies. Even then the knowledge was given with little explanation or discussion. On the other hand, in Bali there was a focus on the sharing and discussion of knowledge in order to give it value. Barth argues that these differences helped to explain some of the cultural differences that he observed. Different ways of knowing were created by the ways in which knowledge is shared (pp. 644). When it is shared in different ways then it is integrated into society differently and these effects can extend throughout the social and economic sphere. Through variation in how knowledge is treated, and which aspects are valued, knowledge can serve many functions in a society.

Knowledge is seen by Barth (1995) as a way to view culture. It allows for observations on how people engage with the world and presents a globally continuity of culture as knowledge interacts between and within groups. Using this perspective it is possible to locate the social changes that are occurring around the Ngel Nyaki reserve within a discussion of the spread of scientific methods and knowledge due to the presence of a research station and a conservation programme focused on the protection of biodiversity. Despite the increasing influence of science brought by the research station, there is still significant interaction between the scientific knowledge system of the researchers and the local knowledge systems of those who

work for the station. The interaction between them affects both the practice of science and local knowledge.

Scientific Knowledge

Scientists have not always been synonymous with academically educated professionals. In 17th century Europe they were generally interested amateurs referred to as natural philosophers. At this time they did begin to form scientific societies as a place to collect and clarify knowledge and perform experiments (Ziman, 1976:48). It took until the 19th century for science in Europe to become academicised (pp. 55). The number of scientific journals doubled every 15 years between the 18th and 20th century and has continued to grow to the present (pp. 56). The word scientist was invented in 1840, by which time the practice of science had become linked with academic posts rather than the hobby of amateurs.

Scientific knowledge grows through both the accumulation of observations and through the testing of theories (Popper, 1963b; Popper, 1963a) . As theories are disproved and new ones are suggested it leads to new observations and new directions for scientific knowledge to follow. New theories should be able to explain and predict more than the ones they replace by making more precise assertions that can be tested with more precise tests. This does not necessarily mean that science is progressing towards an objective truth about the world, rather that the theories learn from earlier mistakes. Each new theory raises new problems for scientists to examine while connecting or unifying unrelated problems (Popper, 1963b). Scientific knowledge, although sometimes leading towards practical solutions to real life problems, is more concerned with theoretical knowledge and the ability to apply any knowledge gained in a universal, rather than a contextually based way. Knowledge gained by the scientists at Ngel Nyaki, although it may be used there in the future, is intended to be applicable to any forest, not only the one in which it was developed. Knowledge created by the researchers now belongs to the Western science knowledge system, while knowledge produced before the research station belonged to a local knowledge system.

Practitioners of scientific knowledge see it as a universal knowledge that by following strict rules remains objective and universal. Turnbull (2000) traces the development of the sociology of science which, rather than accepting the view of science as autonomous, rational, objective and universal, considers it to be something that can be affected by social context (pp. 4). The scientific knowledge system that I will discuss in this thesis is Western

science. Systematic scientific knowledge has been created by cultures around the world, from China to the Pacific. However the knowledge that has roots in the scientific revolution of 17th century north-western Europe, and has since been developing alongside industrial capitalism, is what is now commonly known as Western or modern science (pp. 5). This is what dominates in the international academic fields, and what is practised by the researchers at Ngel Nyaki field station. In the case of scientific knowledge, information is combined with the influence of a series of rules that correspond to the scientific method. People with varying levels of education and interaction with the scientific method view the world more or less through the lens of Western science knowledge. With its strong links to academia, science knowledge tends to divorce itself from context as often as possible (Barth, 2002:2), instead choosing to focus on information that is stored in academic documents. Even within the scientific knowledge system there is variation between different types of science; physicists have a different series of interests than biologists (Terrell, 2000). In this thesis science knowledge will refer to that of biology and ecology as they are the main areas of science practised at the field station.

> *"Scientific research clearly does not take place in some sociopolitically neutral environment, the place where those who quest after 'pure knowledge' live. Place, culture and time heavily inform it, particularly interpretation of scientific findings and the uses to which we put them." - (Stillitoe, 2007:13)*

The scientific knowledge system is controlled by knowledge and experts. As the information from the forest is being collected by those invested in science, the forest is becoming a knowledge society, one that values and focuses on knowledge and information that can only be delivered by a select group (Knorr Cetina, 1999; Stehr, 1994).

> *"The major differences between Western science and other knowledge systems lie in the question of power. Western science has succeeded in transforming the world and our lives in ways that no other system has. The source of the power of science on this account lies not in the nature of scientific knowledge but in its greater ability to move and apply the knowledge it produces beyond the site of its production." - Turnbill (2000:39)*

When knowledge is viewed as being socially constructed then Western scientific concepts are 'ethnoecology' in the same way as any other locally produced knowledge (Milton, 1997:485). The scientific method, a cornerstone of scientific knowledge, requires a scientist to follow a series of steps in order to gain knowledge about the world. In their most simplified form these

steps are observation, hypothesis, prediction and experimentation. Beginning with a natural phenomenon, the scientist observes what occurs, hypothesises about what process is behind the phenomenon, uses existing theory to make predictions and then conducts an experiment to test the hypothesis. Through experimentation the hypothesis is modified until it adequately explains the phenomenon. Then the experiment must be tested and validated by other scientists before it is accepted as part of the universal scientific knowledge. By requiring a strict set of rules, including a repeatable experiment, scientific knowledge can be spread throughout the world. Any piece of knowledge that is to be added to the knowledge set is clearly explained in an academic paper, following a specific set of rules that allow it to be recreated locally by other scientists. Standards for scientific language are also intended to allow the easy spread of information throughout the scientific community. Documents produced in one country should be understandable in countries throughout the world. This standardisation of language is evident throughout the different scientific fields. An international standard (SI unit) is available for everything from distance to the universal gas constant. The purpose of this is to make it possible to apply information and knowledge gathered in one place in any other place. Scientific knowledge is at its ideal, universal knowledge. Systems are put in place to describe and categorise as much as possible, with the intent being to one day categorise everything according to an accepted standard.

Paradigm

Kuhn's work *The Structure of Scientific Revolutions* (1996, first published in 1962) worked on the assumption that the image of science that had been presented in the past was wrong. Past views on science presented a number of difficulties including that discoveries and theories that were previously considered scientific and followed the same methodologies that are used today are now considered inaccurate myths. Kuhn recommended asking new questions about how science develops and to trace what led to the production of science within its own time period and the relations between discoveries in order to trace development more accurately (pp. 3). The scientific method alone is not enough to explain why scientific conclusions change and which new ones are adopted. Kuhn argues that what a person already knows is an important component of what scientific conclusions they will reach, no matter how well they follow scientific method (pp. 4).

Kuhn describes what he considers to be the normal state for scientific research, the way it is practised the majority of the time. Research is based around a small number of scientific

achievements that form a foundation for a particular scientific community. The community works within a paradigm, wherein a foundation is unprecedented enough to attract adherents while also being open-ended enough to leave problems available for the group of practitioners to solve (pp. 10). When scientific communities accept theories such as evolution or quantum mechanics then they begin to work within a paradigm and structure the questions they ask and the methods they use according to the paradigm. Those who work within the same paradigm have few disagreements about the fundamentals of their field as they are explained by the theory or theories on which their paradigm is based but ask questions that are informed by the theory. Biologists will not disagree on the fundamental idea of species having evolved, but will disagree on the timing of evolution or the evolutionary path that was necessary to arrive at a particular species just as physicists who agree on the basics of quantum mechanics will still disagree on the role of the observer. Normal science is made up of experiments that are guided by dominant theories of the time, so as long as the theory holds, there is little novelty in the results that are found. They are as expected, and when unexpected results are found it is due to a flaw in the experiment. It is only when the limits of a theory are reached, when it can no longer accurately predict the answers to proposed questions, that new theories must be proposed and the paradigm begins to shift. Kuhn argues that science is not a continual process of improving knowledge, but it is rather a series of periods where normal science tests the limits of a paradigm until such point as it is proven to be false. There is some overlap between paradigms as those who have been working within the paradigm must change their thinking or be pushed out of the scientific community.

Paradigms shape observation. People within different paradigms look at things differently, observation is always interpreted, not raw. It is guided by concepts and ideas. The ways in which data collected, even from machines, is organised are guided by the paradigm. It also shapes what is viewed as worth studying. The questions that are asked, seen to be important, relevant or interesting, are guided by the paradigm. In either case, science is guided by the theoretical stance taken by the scientist. The idea of paradigm shifts, where there is a clear break and change between paradigms is less clear. Paradigms may in fact be more connected, different parts of them changing at a time. Technology, theory, and methods may not all change at once. But still, the history of science involves change, not necessarily a progression towards an ultimate truth. The idea of paradigms is important to the view of local knowledge and science. Different people may be looking at the same landscape, with the same goal, but with different theoretical understandings of how it functions. Starting with different points of

observation could lead to different ideas about what the problem is, what needs to be looked at and the best solution to the problem.

Local Knowledge

Local knowledge is dynamic, diverse and socially and culturally embedded (Pottier, 2003:7). It is expressed and transmitted in a myriad of complex ways. Zent (2009:46) discusses the development of local knowledge theory and discusses various conclusions that have emerged. Firstly, social organisation of knowledge constrains and patterns knowledge distribution and any change in the physical or cultural environment that affects social organisation will also have an effect on knowledge. Knowledge as a social performance is the second area of research. For local knowledge, knowing context is imperative for understanding. Situational variables change how knowledge is used and as this use changes, people's knowledge adapts to fit the new situation. The transmission and acquisition of knowledge is also important. In places where changes have occurred in the amount of time that young individuals in a society spend in formal schooling or with their elders there can develop a change in which types of knowledge are valued. This can also create a generational effect on knowledge, meaning young and old people may possess different information and processes it very different ways. Local knowledge is a system of understanding and communication that develops in a localised area. It varies within the society as it is adaptable to individual needs and experiences. Interaction with outside knowledge systems can affect local systems to varying degrees, depending on the local requirements.

Interaction between Science and Local

When Western science is brought to a society it can be rejected entirely, incorporated into local ways of thinking or can overrun existing knowledge systems. To what extent it is influential depends on a number of social factors, making the interaction between knowledge systems highly contextually based. Comparisons between Western science and local knowledge have traditionally focused on the 'universal' nature of scientific knowledge (Smith, 2007:78). This overlooks the disparity between the pure knowledge ideal of science and how science is actually practised (see Turnbull, 2000). The translatability of scientific knowledge requires an acceptance that both scientific and local knowledge relate to the same natural world, that there is a separation between humans and the natural world, and that there is a definitive 'real' world that is being revealed through the creation of knowledge (Smith,

2007:79). Viewing it this way, that there is a real world out there, tends to place scientific knowledge above local knowledge as a global institution as it is better able to explain and reveal the reality of nature as a whole rather than knowledge of a small, localised space.

In the introduction to Local Science vs. Global Science, Sillitoe (2007) discusses the interaction between Western science and local knowledge. Scientific theories are rooted largely in contemporary Euro-American understanding of the world. They are one way of explaining our experience of the world that is technically powerful and has a large, effective body of integrated theory. Global science has achieved understanding of natural processes to a point that allows technological advances such as air travel, advanced medical techniques and biochemical alterations at the level of DNA. By looking at other world views and using them to guide scientific experimentation their cultural relevance can be enriched, making scientific interventions more cultural compatible with specific regions and therefore easier and more effective. There has been an influence of local knowledge of the development of science since the enlightenment. Folk knowledge from Europe influenced the development of scientific thought. The local knowledge was renamed natural knowledge and incorporated into classification and ecological knowledge. And observations by local people in the Galapagos Islands were necessary for the development of Darwin's theories of evolution. However local knowledge is on its own geographically and culturally specific, rarely spreading to large areas, it is regional rather than universal (pp. 8). Local knowledge is very heterogeneous, there is variation within each local area and this is amplified as different groups interact and knowledge diffuses between the groups. It also tends to be pragmatic in nature, it is practised rather than recorded. When the people of Ngel Nyaki are separated from the forest and are no longer able to practically apply knowledge, there is question as to how much of their knowledge will still be passed down to further generations. This also effects how much of it can be taken and absorbed by the scientists who are present. The more effective the exclusion of people from the forest, the faster the local knowledge should disappear. It will also mean that groups who do continue to interact with the forest, such as the grazers, are more likely to maintain their local knowledge. This may have several possible effects. Later, if scientists begin to try and integrate local knowledge they will get more from the grazers, allowing the grazers more influence over future development. Additionally, as the knowledge systems of the village are replaced with, or at least highly influenced by, scientific knowledge, at least in areas directly related to the forest, then the people of the village will be in a better position to interact with scientists, putting them in a better position

to take over management of a scientific research station. If they are able to understand and discuss their rights in scientific language then they will be in a better position to negotiate with government agents. Practitioners of scientific knowledge, who have control over access to the forest are in the position to decide how much local knowledge they incorporate into the wider scientific community.

If it is accepted that there is more than one sort of knowledge then it should be possible to observe the interaction between them. Turnbill (2000) proposes that there are multiple forms of knowledge, each type being local, created and maintained through social activity. He includes science in this definition, arguing that the traditional view of science as autonomous, rational, objective and universal ignores the social history that surrounds science as it currently exists. There are other ways of understanding the world that are as legitimate as Western science, each of which is local and has its own knowledge space. A knowledge space is sustained by social labour, the interaction and assemblage of space and knowledge (pp. 1). Knowledge spaces contain people, skills, local knowledge and various types of equipment (pp. 20). Within these spaces, knowledge is standardised, homogenised and connections are created between different pieces of information. This organisation allows local knowledge to be transmitted and used, forming it into a view of the world that can be regarded as truth by the local population, and also something that can be moved through social networks and understood by non-local groups who lack access to the original local information, and see only the resulting knowledge scheme. Science knowledge is made up of a series of local knowledges based on local context (pp. 9). Within science, information moves between local knowledge groups as well as from a universal theoretical set of knowledge to local knowledge. As experiments are designed and carried out under local conditions information is passed in both directions forming a new knowledge space.

Spreading Knowledge

Science has a long established link to technology. In some cases the technology allows the development of a scientific theory, and at other times a scientific theory can be used to develop new technologies that would otherwise have been near impossible to achieve. Taking a flight to the moon is one case where an understanding of physics would appear to be absolutely necessary to make the technology work. As the theory is necessary, it has been argued that the scientific theory must then be expressing realities of nature. Gravity and vacuum as concepts must be reflections of a reality because if they were not then a rocket

would not be successfully propelled from the Earth, out of the atmosphere and hundreds of thousands of kilometres through space to the moon. However in some cases the theory lags behind the technology. The technology exists for scientists to alter genes and through this alter expression of a variety of traits, but gene replication and expression is very poorly understood. Science can still be carried out without complete understanding of the processes behind the experiments. Ziman (1976) provides many examples of the different relationships between science and technology. Mediaeval cathedrals were produced through gradual improvement without mathematical calculation of the best ways to build them. Plants were described and catalogued for medical purposes before classification occurred. Instruments like the telescope became useful after a mix of technological advancement and scientific calculation. Plant breeding led to the discovery of genetics but for most of time has been little affected in the opposite direction. In most cases of plant and animal breeding specific knowledge of the functions of genes are not used.

Technology is also vital to the establishment and communication of scientific ideas and data. These can be spread in any number of ways including letters, books, journals, conferences and journalism. In many cases the science is translated into common language so that the message can be understood by those without extensive academic training in a specific scientific field. As tools such as computers and mobile phones become more prevalent in a region then those with local rather than scientific knowledge will gain access to a wider range of people with whom to share their knowledge. However this still creates difficulties when the knowledge must be translated, either the knowledge must be directly translated to another language or it must be adapted to function with the technology. Local knowledge gets more access to these tools when in contact with scientific knowledge, but it requires becoming to some extent part of the Western scientific view. Articles about local knowledge will not be accepted to scientific journals unless they are written in a specific style and follow the rules of the journal. This is also necessary for conferences, knowledge must be framed in a particular way. More leeway is available for popular media, but who is to be reached must be taken into account. If one is attempting to reach those invested in the Western scientific system, one that is heavily linked to international economics, then some concessions have to be made.

Knowledge is formed by the way a person views the world and in turn it affects how the person views the world. It includes a variety of aspects including information, practical skills and emotional responses. Western scientific knowledge is information controlled by a series

of rules that are dictated by the scientific method. This is intended to produce knowledge that is objective and universal. By declaring its objective and universal, science can be used as a social force, overriding other forms of knowledge that tie themselves to local context. Social scientists have increasingly been recognising the influence of social context and local circumstance on the production of scientific knowledge, bringing into question how objective and universal it actually is. Science relies on the use of models and laboratories to explain and recreate the natural world. Information that is used in the laboratory is altered from its original state in order to make it functional and simplified. Experiments are repeatedly adjusted from their theory based beginnings to make them work in the laboratory. All of this provides a local context for science that separates it from its universal ideal. The inability of science to classify all of the information required for completely accurate experiments is demonstrated by the incomplete ordering of flora within the forest. Without some way to access expert botanists and allow them to catalogue the entire forest, the models and experiments created within the NMFP will be incomplete. Researchers at the NMFP are working within a scientific paradigm that focuses on biodiversity in conservation. This paradigm will be explored through the discussion chapters to determine the constructs of the paradigm beyond a general acceptance of scientific method. In order to explore scientific knowledge I first had to construct my research to determine which questions to ask and the most appropriate ways to answer them.

Development of Research Questions

A variety of different types of conservation have been conducted throughout Africa since colonisation. Science has always been a part of these conservation programmes and has had an impact on how they are carried out. Within Nigeria there are a large number of different environmental problems that are currently being addressed, many focused on the use of land as the population increases and land-use needs change.

One main focus of the anthropology of conservation and science studies has been the divide between nature and culture. The idea of nature is central to the research station I did my fieldwork in. Science is used to research nature and to define what is natural in order to create a conservation plan for the forest. As the force behind the research station is scientific, it is possible to address issues of how scientific thinking impacts knowledge production and views of nature. Following from the concept of scientific paradigms, the social aspects of scientific

knowledge can affect the results that emerge from scientific studies. The way in which scientists look at the world is important, science is not simply a direct observation of nature that is analysed without context. A specific scientific paradigm that addresses nature in a particular way would affect interactions between actants at the field station and ultimately affect what is produced.

There is also an opportunity to examine the clash between environmentalism and development. Economics, power relations and political issues related to the forest have both local and more widespread impacts, as do the ecological concerns. Although the research station is focused on scientific research, it includes local development as part of its mission statement. The station is also not operating in a vacuum. Funding, land use and cooperation from local people are all tied into the successful completion of any research at the station.

In this thesis I will be looking at: (1) the role scientific knowledge plays in the conservation of the Ngel Nyaki Forest Reserve; and (2) how the NMFP functions to produce knowledge. From the theoretical stance that science inhabits a unique type of knowledge system I will discuss the interactions between science and other non-scientific systems that are present in the local area. I will investigate how those people involved in the NMFP to varying degrees adapt scientific thinking to work in real-life situations. Additionally I will look at how well the NMFP adheres to scientific knowledge and how this affects achievement of its overall aims. Finally, the paper will address how the presence of a scientific research station impacts local issues that are not directly related to conservation. These are related instead to local ethnographic matters that I address in my literature review. Ultimately the question I will be examining is to what extent viewing the world through a scientific paradigm influences conservation programmes and their outcomes. To this end I will be exploring the relationship between nature and culture, what sorts of networks are formed at the research station and how they are influenced by the scientific nature of the research.

Methods

I conducted my three months of fieldwork in two locations; at the biological field station itself and also in Yelwa village. I lived in the field station for the entirety of the field work. By accompanying both field assistants and researchers while they were collecting data I was able to conduct both formal and informal interviews as well as observe the processes of scientific research for most of the projects being conducted at the time. I also conducted a

series of semi-formal interviews with the residents of Yelwa. Some of the residents were English speakers, and I spoke to them directly. For those who did not speak English, I had the assistance of a translator, a lifelong resident of Yelwa who spoke the two main languages of the village, Hausa and Fulfulde as well as English. Over a month-long period I visited the village daily and spoke to several dozen residents, both singularly and in groups. Most I was able to speak to on multiple occasions on a variety of subjects including their opinions on the NMFP and NCF, their knowledge of the forest and the history of their families. Most male residents were happy to speak to me, especially those who felt aggrieved by certain issues surrounding the field station. Women on the other hand tended to say they had no opinion on any topic. The few women who did feel comfortable speaking with me were high-status women such as village leaders and those who worked in local businesses. Due to time constraints I limited my interviews to people who resided in or were visiting Yelwa, and did not visit the other, smaller, nearby villages. The NCF headquarters are located in Yelwa and perform most of their outreach programs there. The majority of the people who interact with the NCF, excepting the Fulani grazers who live surrounding Ngel Nyaki, live in the village, as do the vast majority of those employed by the NMFP. Visiting researchers are also unlikely to meet people not residing in Yelwa without making a significant effort. Within the village there are representatives of all the major clans and tribes, and practitioners of all occupations that involve or used to involve the forest. Within the village I was able to speak to individuals who varied in education level, occupation, tribe, age, gender, social status and relation to the Ngel Nyaki forest.

Although I spent significant amounts of time in Yelwa I chose to focus my thesis on the field station and the scientists working there for several reasons. Having an undergraduate degree in biochemistry I have interacted with the academic aspects of science in the past and am familiar with experimental practice, although my experience is limited to the traditional laboratory. The lack of a language barrier and the large amounts of time available to observe and interact with the scientific researchers both socially and during the implementation of their experiments provided me with large amounts of data and I believe greater insight into their practices. Additionally, the application of science to conservation is a large field that seems likely to continue to grow in the future, making studies of the interaction a field I think is important.

In the next chapter I discuss three specific research projects that took place at the field station. The chapter addresses the research questions by exploring differences and similarities between the projects and how they affect the conclusions that are drawn about primates within the forest. I focus on how the networks established by each research project influence the science that is practised. Additionally I explore how well a single scientific paradigm describes and explains the practices of the three researchers as a group and if this scientific paradigm can then be used to understand the conservation policy of the station.

Chapter 3. Ethnographic Study of Work in a Field Station

Within the field station a number of research projects are carried out with the goal of gaining scientific knowledge, but each is uniquely designed, providing different outcomes. At the time I was conducting field work two were actively being conducted by researchers who were present at the field station. Data was being collected by field assistants on behalf of absent researchers for a number of other projects. In addition there was an independent personal project being conducted on behalf of a professor to save the lives of three monkeys. Each research project that is conducted at Ngel Nyaki is designed by an academic, usually from a scientific field such as botany or primatology. Data must then be collected through either experimentation or observation, after which it is analysed and conclusions are drawn. Who conducts the data collection is extremely flexible, some researchers are present for all data collection while some rely almost completely on field assistants to carry out the project in their absence. Projects vary greatly in their scope, however they all require the formation of a laboratory within the forest, and they all provide knowledge about various aspects of the forest, leading to a greater understanding of the forest as a whole. The boundaries of the laboratory, the object of study, the type of data collected and the tools used to do so all impact the knowledge that is produced. Altering the experimental design and procedure alters the results that are produced and therefore the conclusions that are reached, this in turn alters what is known about the forest. The scientific facts about the forest are influenced heavily by the people involved in the scientific research. This chapter will focus on how two constants throughout all of the projects, field assistants and primates, perform different roles in each project and how these differences lead to different knowledge about the forest.

A laboratory creates a space within which objects and nature can by physically transformed and moved, while natural cycles can be bypassed (Knorr Cetina, 1999:26; Turnbill, 2000:10). It can be created anywhere, and be structured in the way best suited to the scientist. Each of the projects observed was focused on collecting data about a different part of the forest, and then used this data in a different way. By using different sampling techniques, and locating the research in a specific location, a laboratory was formed by each researcher that controlled the amount of data available and allowed a coherent network to form around the experiment. It would be impossible without unlimited resources to collect data from the entire forest, so each project designates which specific regions they will focus on. Decisions about the scope of the laboratory can be influenced by ease of access, location and concentration of a specific

species, past data collection as well as other factors. Each of the projects I discuss in this thesis had different ranges for their laboratory ranging from a small cage to large sections of the forest that are largely untouched by other researchers. By designing the laboratories in specific ways, the researchers were able to exert some control on the production of knowledge from their projects.

Data collection is a vital part of forming a scientific knowledge system. In order to determine the state of the forest, data must be collected that describes what is going on in the forest. It is also necessary to collect data through experiments in order to be able to come to conclusions that can be added to the collective science knowledge. The field station attempts to organise the information available from the forest into a set of useful data that can be used to form scientific conclusions for academic purposes and at the same time to influence the ways in which the forest is managed and conservation projects are handled in the future. This is in line with attempting to achieve the first two aims of the NMFP. The main sets of data that are being organised by the various researchers involved with the forest involve the trees and plants, focusing mostly on their seeds, and the animals of the forest, primarily insects and primates. Collection of forest data relies heavily on both field assistants and the conditions in the forest. Both of these forces impact the extent to which data collection can adhere to the rules of the scientific knowledge system. In order for a project to be considered successful, the data collected must provide a representative sample that can be used to describe a whole species or indeed the entire forest, depending on the scope of the research. Data collected about a specific forest becomes part of the scientific knowledge network and is used to describe nature on a global scale.

Levels of access to the forest and the data collected about the forest vary between those with different roles in the field station. Those researchers located overseas have access to large quantities of data collected in the forest, giving them an idea of animal numbers, behaviours and movement, of the types of plants and trees present and how seeds are dispersed from these flora. This data is available through three means of transmission, data collected at the field station is entered into the computer and then sent to and stored in overseas computers, data is carried back by individual researchers and finally through the research that has been published in academic journals and presented at conferences is available for any member of the academic community. These data are also available to those researchers at the field station. Additionally they have access to the forest itself and the knowledge of the field

assistants who have been living in proximity to, and working within, the forest for extended periods of time. Field assistants have extensive observational data as well as access to the raw data of the researchers they work with. However as research data is usually not explained to the field assistants, they are not generally made aware of the purpose of the data collection, and how it is to be used in the future. They have not been trained in academic methods of analysis and do not have the computer skills necessary to use scientific data analysis programs. As purveyors of long-term observational data from the forest the field assistants are invaluable, but most of the analytical results are unavailable to them. Although academic articles related to the forest are made available in the field station library, they are written for an academic audience and are difficult for those with little education and limited English skills to read and understand. Individuals view the forest differently and the ways in which they interact with data from the forest influences this.

In the following sections I look at three specific projects that were being carried out at Ngel Nyaki while I was conducting my field work. They all look at different aspects of the forest and each constructs their laboratory differently. The technology and social networks required by each are also different. I will analyse how this affects the knowledge created about the forest. Finally I will argue that by framing the primates in different ways, each experiment represents primates differently and creates a different idea of what a primate is. The construction of the projects affects both how nature is viewed, as represented by primates, and also how local people interact with scientific knowledge.

Caged Monkeys

Several troops of wild tantalus monkeys live in the Ngel Nyaki forest. As well as these wild monkeys there are also three monkeys who were brought to the field station from a nearby city and are currently being kept caged within the forest. While taking place within the forest reserve and involving people working at the field station, it remains an independent project. Oliver, a student who had come to the field station to study the caged monkeys described the project as attempting to:

> *"softly release 3 captive tantalus monkeys into a wild troop whose home range surrounds their cage. And to determine the captive monkeys' activity budget and to incorporate wild, natural foods into their diet, while observing their reaction to the presence of the wild monkey*

troop. I am also habituating the wild troop so we can monitor the captive monkeys' progress, if they indeed are released and accepted into the wild troop."

This project is not a scientific one in the strict sense, it is not an experiment, however it is still based on scientific conservation paradigm. Originally the monkeys were placed in the cage simply as a way to save them from being killed. However the way in which they were taken care of while in the cage shows a distinct difference in how primates are looked at by scientists and those local to the forest. Prior to Oliver's arrival the monkeys had been fed by local field assistants. No reports had been made of their activity or behaviour and the only information about their interaction with wild monkeys was passed along in casual conversation. Feeding had also been largely undocumented outside of a record of purchases in order to recover costs. When Oliver first went to observe the condition of the monkeys they were being given whatever food was cheaply available with no concern as to its relation to what they would have eaten had they been wild. Those local people employed by the field station often expressed their bemusement at the amount of money and time spent on the caged monkeys, especially the effort put into procuring and preparing a variety of fruits. While in the cage, the monkeys are seen to have scientific value by researchers as well as the intrinsic value of having saved their lives. Behaviour of captive monkeys can be used to determine behaviour of the more difficult to observe wild monkeys. This includes feeding, gut retention times and copulation. In addition it brings the wild monkeys into an observable position as they interact with the caged ones. For approximately six hours a day over a period of six months Oliver recorded the behaviours of the caged monkeys. He observed the eating, sexual and grooming habits of all three, and could after a few months accurately predict their day to day behaviours and recognise patterns. Also, when wild Tantalus monkeys approached the cage Oliver observed their behaviour, the caged monkeys' reaction to the wild monkeys and when possible followed them to determine the behaviours of their troop. Although the project was designed to reintegrate the monkeys into the Ngel Nyaki forest, this is currently unlikely. The behaviour of the caged monkeys when they briefly escaped from the cage, which involved them attacking field assistants, combined with the likelihood that they would steal food from the field station due to their limited fear of humans, means it is likely that the monkeys will be rehoused in a sanctuary or zoo rather than released to the forest.

This project studies a single species of primate that resides in the forest. Three individuals of the species Chlorocebus *tantalus* are the source of the data generated by the project. These

three are not originally from the local forest, having been taken from captivity in a village, and are living within a cage that separates them from the rest of the forest. The project was designed by a professor of ecology who resides outside of Nigeria, but was present to set up the original cage. All data collected is transmitted to the professor on a daily basis, subject to the availability of an internet connection. Although there is significant contact between the professor and Oliver, there is little direction given as to the specifics of how the project is to be conducted, relying on Oliver to apply his own skills developed both in university, and in prior primate observations projects that included both caged and wild subjects. Data collected from the project is seen as representative of the species as a whole.

Behavioural information is the main focus of data collection for the project. This includes diet, social and sexual data. Incidents of grooming, fighting and a variety of other behaviours are noted on worksheets. The collection method uses direct observation on a daily basis. Due to the reliance on observation, there must be a paradigm in place to decide which observations should be made, to determine which behaviours are important. Observations about feeding, social interaction and sexual behaviour will be useful to the research station in the future while detailed observations of vocalisations are less useful in the context of a conservation programme, while they would have been considered more useful in a research station designed specifically around primate interaction. There are approximately six hours of observation recorded per day, throughout the entire week. Observation begins as early as seven AM and ends as late as eight PM, which is sunset. Observation is conducted during all weather, during my period of fieldwork it rained for about half the day every day and although data collection was focused on the dry periods when the monkeys were more active, it also took place during periods of rain. Long term patterns were established for the observed behaviours as well as behavioural changes throughout the day.

The laboratory used in the project is almost entirely contained within two cages connected by a door. The largest cage surrounds a tree and also contains several lengths of wood and piping that are included to give the monkeys full use of the caged space. The smaller cage houses a sheltered area, two food bowls and several water bottles. Access to the forest outside the cage is limited. Insects and small animals are able to enter the cage, nearby plants do grow into the cage and there is some social contact between the caged monkeys and local wild troops. Foods from the forest are introduced to the cage, and due to this, the monkeys are influenced somewhat by the changing fruit patterns of the forest, insomuch as their diet

alters according to the availability of wild foods, albeit they are not subject to food shortages due to the provision of fruit from local markets. While a normal troop moves throughout the forest through different terrains, the laboratory limits the area of observation to one environment.

The set-up of the laboratory impacts the social network of the primates. Observation of the monkeys is conducted from the edge of the cage and Oliver wears only colours that blend into the forest as part of an effort to be as unobtrusive as possible and be ignored by the monkeys. However there is still significantly more human interaction for the caged monkeys than there would be if they lived anywhere else in the forest. They are reliant on humans to provide their food, and are unable to forage beyond the occasional insect. Humans become associated with guarantee of a food supply rather than as the predator they are to the wild monkeys due to continued hunting of primates within the forest boundary. There is also significantly less socialisation for the caged monkeys than would be present in the wild. Instead of the usual troop, the ones I observed in the forest contained over ten individuals, an artificial family group is created within the laboratory. Both socialisation with humans and with other primates are influenced by the laboratory.

There are a variety of people involved in the care of and research surrounding the caged monkeys. Social networks are utilised by Oliver to attain food from both local markets and the forest itself. Field assistants working on other projects bring back a variety of forest foods. These foods will vary depending on the regions of the forests they are collecting data in and where forest food is available. At times when fruit and berries are limited there is more reliance on local markets and non-forest food. Due to limited variety of fruits available in the village, people must be sent to nearby markets to collect food. This involves taking either a car or a motorbike. Within the village vehicle ownership is rare. When people need to travel they must utilise the car or motorbike taxis that are operated by men in the village. The two closest markets to the village are approximately an hour away by car so any trip to collect food for the monkeys is combined with other business in order to lessen the travel costs. As well as providing fees to the taxi driver, buying outside food also subsidises the travel of villagers who may be travelling to visit family or to transact business. The selection of which driver to use is made by one of two workers at the field station who are sent to collect food, so they are able to favour particular drivers if they so choose. The caged monkeys are

completely reliant on human social networks within the field station and extending into the local community in order to survive.

In addition to food collection, field assistants provide useful behavioural information about the monkeys. Many have observed them and dealt with them since they were first brought to Ngel Nyaki, which in the case of the baby means they have been observing her for her entire life. For the field assistants this is the first group of primates that they have been able to observe consistently in a controlled environment. The other interactions that they have with similar primates contain very different dynamics. While in the forest the primates are usually observed at a distance as they are wary of human interaction. This contrasts with the experience of feeding the caged monkeys by hand and in some cases petting them, something that never occurs in the normal forest context. The construction of the cage has produced relationships between people and primates that never occur in the wild. The caged monkeys react differently to humans and humans react differently to them. Observations are made about the different personalities of each monkey and how they react differently to different people. When repairs are needed on the inside of the cage only one person is willing to enter the cage to make them. The monkeys know and like him, whereas one of the monkeys actively dislikes the man who accompanies him. Without the cage there would be no attribution of emotions to the primates, simply because it would be impossible to create interactions of that sort between primates and humans in the normal forest setting[10]

Actions that are performed normally by primates are viewed differently in the context of caged or wild. When the caged monkeys ate food such as peanuts or bananas in the same way humans do it was remarked upon with interest and in a generally positive way. During complaints about wild primates raiding local farms the similarities between human and primate eating behaviour was also mentioned, but it was always referred to with frustration and negativity. Similarities between primate and human behaviour were viewed as the primates deliberately mocking farmers as they knew they were not in danger of being killed. On the whole the caged monkeys were viewed more positively and interactions with them were valued more highly than those with the wild tantalus.

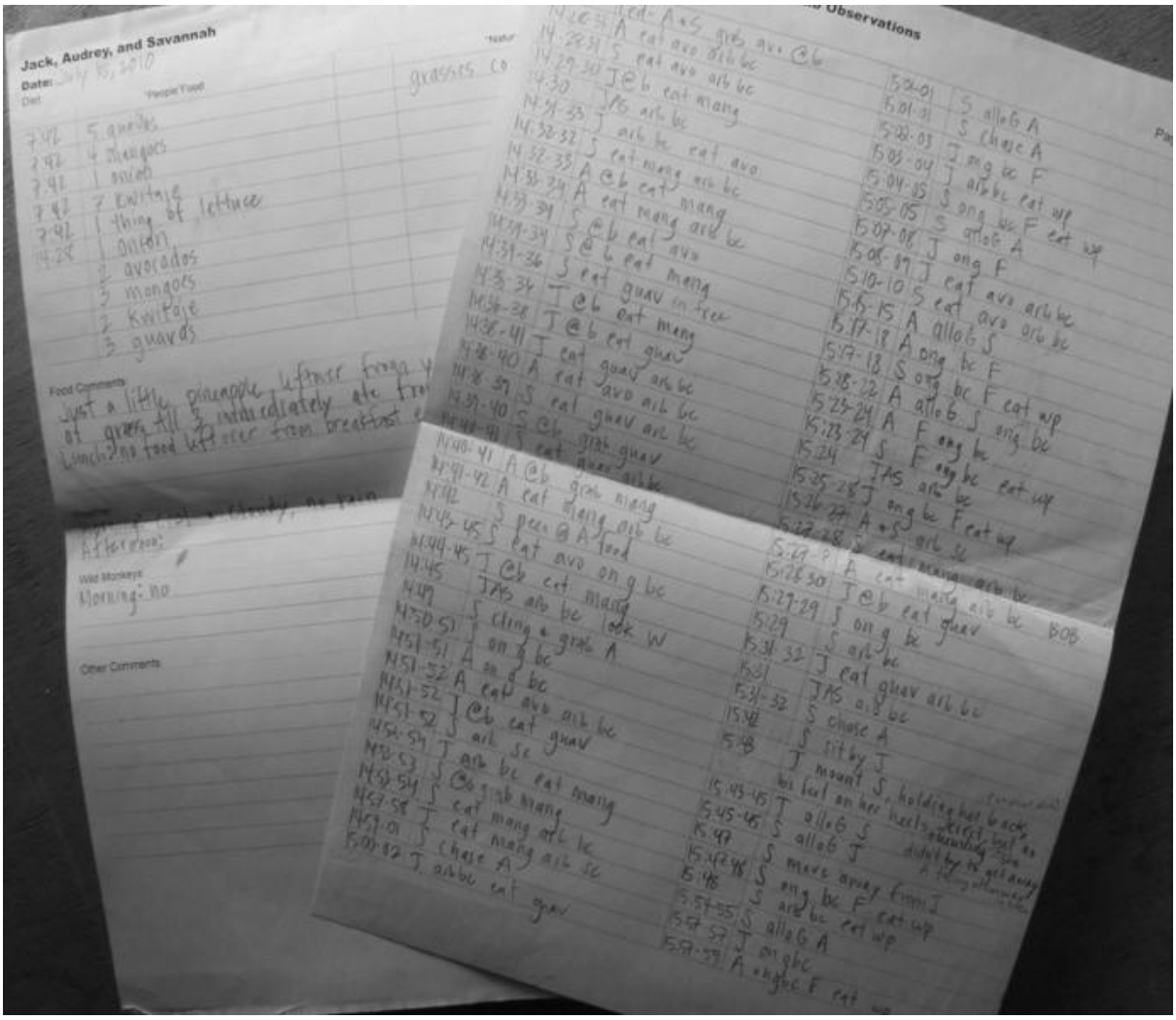
[10] The behaviour of wild monkeys and poachers combined with the forest terrain, including the height of trees and difficulty moving through the forest quickly, makes it effectively impossible to habituate and interact closely with tantalus monkeys.

Picture 2: Wild Tantalus are observable only from a distance.

Picture 3: Caged tantalus are easy to interact with up close.

The history of relations between the wild monkeys and caged monkeys is also important due to the relatively short duration of the project. Changes in behaviour and levels of interest or aggression between the two groups have to be taken into account before any decisions regarding release can be made. As primate behaviour changes between the wet and dry seasons information must be gained from field assistants as to how the primates interacted the half of the year when the research project was not taking place in case issues such as food availability caused major tensions between the wild and caged groups that would affect the possibility of a successful release. Ultimately decisions regarding the project are made by the project supervisor, so maintaining contact between local researcher and supervisor is vital. Those with long term knowledge of laboratory primates and the forest primates are best situated to decide how well the two compare with each other.

Compared to other projects, the caged Tantalus project uses simple tools for data collection and analysis. Observations are recorded in a notebook, or onto a variety of printed data sheets specifically designed for the project as it progressed. A camera and binoculars are used to aid in observation and a laptop is used to collate data and transmit it to the project supervisor. Binoculars used to observe the cage from a distance to allow wild monkeys to visit without the presence of a human dissuading them. They are also used to observe and estimate the distance of wild monkeys from the cage, in order to record troop numbers and patterns of behaviour. The observational data from the notebook and data sheets are entered into the laptop, not in their entirety, but including only important patterns of behaviour, how behaviour changes throughout the day and how much interaction there is with the forest in the form of foods and wild monkeys. Additionally observations are recorded on how they react to the various aspects of the forest that are introduced to them and reports are made of any odd behaviours that are developing, such as chewing on and licking parts of the cage, so these can be resolved. Records are also made through photographs, especially for such things as documenting injuries. Recording direct behavioural observations is the main source of data for the project.



Picture 4: Daily observation sheets recording behaviour.

Worksheets are directly created in the laboratory by Oliver to record details of food consumption and behaviour. At the beginning of the project every single behaviour of interest was noted in a notebook. As patterns emerged over time data sheets were created to simplify observation by focusing on main behaviours. These data sheets are analysed directly in the field station to produce descriptions of an average day, with main focus made on any abnormalities of behaviour. These descriptions are then sent to the project supervisor. The data is not currently being analysed any further, but the raw data is being preserved in case it is useful for analysis in the future. The data sheets reduce the behaviours of the monkeys to a series of codes that describe the action taking place, where it takes place and which animals are involved. Only the actions that are deemed by the observer to be relevant are recorded, actions that are easily observed and which are recorded without explanation. Oliver did observe that the male would, if given the opportunity, eat all of a specific type of fruit, the type of which would change every few weeks, by blocking access to the small cage for the

other two until he had finished eating. This sort of behavioural information was not collected as it did not fit into the data collection method that had been chosen. When the primates were being located within the cage they were described as being arboreal or terrestrial and in the large or small cage. As the tantalus is primarily arboreal the time they spent on the ground is important as an aberration from the normal, and the differences between the two cages could provide some information about how the primates were relating to each other based on their location. Using the information collected by Oliver, the suitability of the Tantalus' for release into the forest is being determined. At the moment it is being used to keep the primates contained, due in large part to information collected not through Oliver's direct observation of the monkeys, but through information gained by conversing with field assistants about the Tantalus' behaviour during a previous escape from the cage. Outside of the network of the field station, only the data collected on worksheets is available to represent the caged tantalus to the larger scientific network.

Data collected from this project is available to the entire field station and can be used to provide information about some actions of the tantalus who live in the forest. Gut retention times are one piece of data that can be extracted from the caged project. In the wild it is difficult to identify individuals within a group and calculate how long digestion takes through simple observation. For those working on projects that are studying the tantalus monkeys the cage provides a controlled observation point and with access to the raw behavioural observations gut retention times can be determined. As the types of food eaten are also recorded the effects of a change in diet can also be closely monitored. There are academic resources available that have estimated gut retention times for wild tantalus monkeys, including at least one determined within this field station so there is an opportunity to compare wild and captive populations.

The three tantalus in the cage are seen as representative of their species as whole in some ways, and representative only of captive tantalus in other ways. Protecting the caged monkeys is seen as important for them as individuals, while the conservation of biodiversity in the forest is seen on a larger scale. The wild monkeys are not to be conserved as individuals, but as part of an ecosystem. Distinctions are drawn between captive and wild monkeys. Some of the captives behaviour is not seen as normal for a wild monkey, hence them not being allowed to be released. Although a certain level of acclimatisation is required for any observation of wild monkeys too much is seen as abnormal. The normal behaviour

expected of a wild tantalus is seen to be fear of humans and when a monkey has become used to humans and is willing to approach them then the monkey is no longer seen as being acceptably wild. The main evidence of their lack of fear of humans was their raid on the field station kitchen. Their willingness to venture that close to people, and their view of humans as a source of food were seen as problematic. However the wild monkeys consistently raid local farms during times when forest fruits are low and exhibit limited fear of humans. The local farms and field station kitchen are described as being different, creating a divide between what is natural behaviour for a monkey and what is unnaturally created by human action. Food taken from farms, although it has been specifically planted and tended by humans, is seen as being still within nature. Once the food has been harvested and stored, the food taken from the kitchen is unprocessed any other way, it is seen as being part of the human domain, which is to separate from that of primates. The forest is seen as a shared space to a certain extent, and this extends to the farms, at least in the minds of those at the research station. Farmers construct the line differently, without the intervention of law they would kill primates raiding the farms, as they view their farms as not part of the natural habit of the monkeys. I discuss the differences between local and field station views of the primates further in chapter four.

Expectations of tantalus behaviour by the researchers are collected from formal education, including academic articles, experience with primates in other locations and observation. Within the cage there are several wild behaviours that are not possible. Aside from the confinement to a small area which affects eating, drinking and territorial behaviour, the inability of the monkeys to leave or to socialise closely with others creates distinct differences between the caged family group and wild groups. In the wild females normally remain in the same group for life while the males leave and join a new group. Mating is not exclusive, males mate with several females within the group. Childcare is shared among the females, rather than a mother being wholly responsible for her offspring. None of these behaviours are possible for a caged pair who are moved to a new location where they then produce offspring. How much this may affect other behaviours is not given specific consideration, more focus is put on the behaviours that are seen to be caused by the actual confinement. When observed behaviour deviated from expected behaviour it was usually attributed to captivity.

This particular project has limited applications to the forest as a whole due to the artificial nature of the laboratory and the unlikely nature of the monkeys release. As it is technically separate from the other research taking place at the field station it has value other than its contributions to scientific research. One useful aspect of the project is it's potential application as an educational tool. Caged primates give opportunities for close access that would otherwise be unattainable. People who lived nearby expressed an interest in visiting the caged monkeys, even those who were generally apathetic towards the forest primates. It also promotes the idea of conservation in a different way than the other projects at the station. By focusing on the saving of several individuals rather than an entire species or forest it allows for a more personal understanding of conservation. While the forest reserve creates a separation between people and the forest the caged monkeys allow people to reconnect with part of the forest. Although Oliver's actual caged monkey project says little directly about the forest, it did lead to a side project that was more enlightening. While in the village, Oliver was continually told about the damage primates do to the local farms. This led to a study of the impact of forest conservation on the local residents. The ways in which humans related to the caged monkeys compared to wild monkeys demonstrates the separation people create between wild and captive primates.

Chimps

When primates live in the wild as a group their movements may be difficult to predict and specific individuals can be hard to identify even with long-term study. For those researchers at the field station studying chimps, nearly all of the data regarding their behaviour is collected hours or days after they have moved away, as actual in-person observation is rare and difficult to orchestrate. At Ngel Nyaki there is a research project, run by Samuel, focused entirely on the chimpanzee population of the forest. The Nigerian Chimpanzee that resides in Ngel Nyaki (*Pan troglodytes ellioti*) is the most endangered chimpanzee subspecies and little information is known about its behaviour in montane environments. Due to this, the research project is designed primarily to provide information about behaviour, including information about technology and behaviour surrounding food and food acquisition. The set up of the chimp project is completely different from that of the captive tantalus project as it relies on indirect rather than direct observation and covers a much larger area of the forest.

This project has two distinct sections, one involving direct interaction with the forest and one that processed objects from the forest in a separate laboratory. The networks that were used for each section were slightly different. The first section, observing chimps and their artefacts relies heavily on the two field assistants who work on the project in the forest. This section interacts directly with the forest, relying on the researcher and field assistants to physically walk through the forest and search. Technologically it requires a GPS, measuring devices and camera to collect the data for recording onto handwritten worksheets. The data is then entered into a computer to be tabulated and analysed. For the second section, drying dung in order to identify and experiment on consumed seeds, there is a much stronger reliance on academic networks. A standard scientific experiment was performed on seeds collected from chimpanzee dung. Using experimental and control groups of seeds the experiment attempted to determine the effects of passing through the digestive system and the use of dung as a fertilizer on the germination of commonly eaten seeds. Although the field assistants are involved in collecting the dung, after it is separated from the forest they have no more involvement with the research. The second section of the project works to translate the place of chimpanzees within the ecology of the forest, explaining how they are involved in growth and regeneration of the forest. This translation relies on botanists identifying the seeds and structured experiments to determine the influence of chimpanzees on seed growth. As the chimpanzee position is translated it becomes represented by numbers of produced objects such as nests and tools and the results of seed growth experiments. The two section of the project combine to provide a range of knowledge about the chimps and their place in the larger forest.

The range of the chimpanzees extends throughout the forest so in order to collect information on them it is necessary for Samuel's laboratory to encompass as much of the forest as he can reach by foot. Of all the projects I observed, his covered the largest area of the physical forest and required visiting areas with difficult terrain to navigate. When these are found the location is noted on GPS, all material is measured, noted and described. Dung samples are collected and brought back to the field station for later processing. In addition to the forest itself, Samuel also constructed plots for planting seeds obtained from chimpanzee dung for additional experiments. By taking varied routes through the forest, it is possible to locate evidence of a chimpanzee presence primarily through the location of dung and used nests. A wide range of tools are used to process the data retrieved from these forest trips including a variety of measuring tools, a drying oven and a herbarium to preserve and identify the

extensive collection of seeds retrieved from the dung. Samuel has made multiple trips to Ngel Nyaki over a couple of years. At the times when he was not present in Ngel Nyaki it was necessary for him to rely on his field assistants to maintain his experiments and data collection. During his absence they are expected to walk the forest locating used nests and collecting dung. The actual processing of the dung that they find is done by Samuel when he returns. To collect information about the chimps a laboratory covering their range in the forest is necessary, but in order to collect data about their impact on the forest as a whole the laboratory is narrowed to a place where there is more control over other factors from the forest.

The types of data collected are direct recordings of items left behind by the chimpanzees, both things they constructed and their waste products. All are physically counted and measured and located within the forest, while the dung is later dried and taken apart in order to determine what the chimpanzee diet consists of. Tools that are found are catalogued to provide evidence of what technology is used. During my observation several sharpened sticks used for digging were found in the areas near nests, usually in the vicinity of termite or ant hills. The nests the chimpanzees build are located in trees so a significant amount of data is collected regarding their location. In addition to a count and co-ordinate location of the nests their height and position in the tree are also recorded. The tree height, diameter and species as well as the slope of the terrain, distance from fruit and water and air temperature are among some of the measurements taken in order to provide a more accurate picture of the environment surrounding the nests and the behaviour of the chimpanzees. Data on the diet of chimpanzees is collected through faecal samples, found remains of food, information gleaned from the use of tools and also through direct observations made through motion-activated cameras that were set up throughout the forest. Diet changes and nest building environments are useful both for providing information directly about the chimpanzees, but also for providing a broader outlook on the state of the forest.

The items left behind by the chimpanzees are used to extrapolate the numbers that are present in the forest using previously established formulas. Chimpanzee numbers are determined by counting nests. Due to their extreme elusiveness it is difficult to get a direct count of the troop. The original strategy for determining nest numbers in Ngel Nyaki was by setting up a series of transects through the forest and following them at various times to identify any nests that appeared along them. This strategy had to be changed when there were no new nests

appearing on the transects, and the sampling method was changed to a more random sampling, where various parts of the forest were visited and inspected without following a specific path. Had the original method been continued, the estimated number of chimpanzees in the forest would have fallen to zero. Although the actual population may have been growing, the scientific estimation would have suddenly fallen. As the ways in which data is sampled will produce different results in an uncontrolled laboratory such as a forest it is necessary for researchers to explore a variety of different methods. This is especially true in a place such as Ngel Nyaki where parts of the forest are difficult to get to and the object of study is alive and may actively try and avoid locations where a researcher has been. These mathematical formulas are available in academic papers and books, having been developed in the past through observations of chimpanzee behaviour. Discarded items are also useful for determining the impact primates have on the forest itself. As they eat and move on they spread seeds throughout the forest and there is some evidence from the experiments conducted on seeds found in dung that the act of eating the seeds alters them and may make them more likely to flourish and grow. These actions involve the chimpanzees in the patterns of plant growth within the forest. Changes in chimpanzee numbers and behaviour, due to actions such as hunting, will lead to changes in the development and growth of the forest as a whole.

Field assistants are integral to this project, however little knowledge transfers between them and other parts of the network. No special knowledge about the forest is required of the field assistants. Although they walk through the forest, there is little direct interaction with the chimps, only with the objects they leave behind. All the interaction is done through representations of the chimps and these do not become representative of the chimps until they have undergone analysis. As this is something that takes place outside of the forest, the field assistants have little input beyond collection of data. They do have some interaction with the scientific knowledge, they learn proper collection techniques and how to use a variety of technologies. Field assistants involved in this project also understand its purpose. Information gathered about the chimps serves no purpose to the field assistants outside of the bounds of the project, it does not change their conception of what the forest is.

This research focuses on the state of one species within the forest and the impact that that species has on the forest as a whole. Although the main impact is knowledge gained about the Nigerian Chimpanzee there are additional benefits to the research as it can help with forest

management in the future. The data collected will provide previously unknown knowledge that can be used for management and conservation of the chimpanzees. By using the forest as a laboratory it was also possible to notice behaviour patterns such as the chimpanzees only nesting on one side of the forest, something that would not have been noted with a smaller laboratory. Habitat and dietary assessments of the chimpanzees also add to the knowledge base regarding flora of the forest as these must be catalogued. If an unknown seed species is found in dung then attempts are made to identify it, which increases the knowledge base of the botany based researchers and provides a more complete picture of the forest as an ecosystem. Experimenting with dung and plant germination allows for the chimpanzee to be placed within the forest system and demonstrates some of the interconnectedness of primate study and forest management.

This project provides information about the forest to other researchers as it accesses parts of the forest that are generally not visited. It also provides information about the chimps that is not available anywhere else due to rarity and isolation. This is especially useful when researchers are trying to provide a overall picture of ecologies within the forest. The germination trials are an example of this, providing information that can be useful to those studying seed germination and others who are not interested in directly studying primates but need to be aware of their effect on a variety of aspects of the forest. In addition to his own knowledge of primate behaviour Samuel also relies on information from previous botany projects to identify which seeds have been eaten by the chimpanzees. By keeping the subject narrow, one particular species, but at the same time expanding the laboratory to encompass a large range through the forest, this project provides fewer direct observations of behaviour while massively increasing the number of indirect observations and increasing the similarity of the laboratory to the actual forest. This increases the complexity of the data gathered, requiring a larger number of tools for analysis. Tools and nests left behind are used as representatives of the chimpanzees. Dung is also used to represent the chimpanzees, but instead of representing the individuals it represents their place within the greater ecosystem of the forest. With a laboratory firmly placed in the forest, this project uses data and technology to create a picture of chimpanzees that is only made possible by using a scientific approach.

Modelled Seed Dispersal

One project at Ngel Nyaki that I was able to observe beginning with its early stages was an attempt to create a computer-generated representation of seed dispersal within the forest. Previous computer generated models of seed dispersal did not include the behaviour of frugivorous animals who are primary and secondary dispersers and seed predators in their models. This is to be rectified in this model by combining data collected from previous projects with data collected by the researcher and his field assistants. This data will then be combined with algorithms in order to demonstrate how seeds are spread by both monkeys and other methods such as wind. It will be based on empirical data collected from primarily primate dispersed forest tree species and combined with behavioural observations in the field, data for fruit production and seed densities of dispersed and non-dispersed seeds and direct estimates of seed dispersal distances. The model will eventually describe the behaviour of frugivores, secondary dispersers and seed predator behaviours. Additionally the simulation intends to describe tree fruit availability. By observing this project it was possible to observe the transference of knowledge and interaction of knowledge spaces that occurs during a scientific research project. The laboratory in this project was primarily within the realm of the computer, but it made use of the laboratories set up by previous experiments. The project focused on gaining knowledge about the forest as a whole with data collected on individual species proving useful only insofar as it described their part within the whole-forest seed dispersal system.

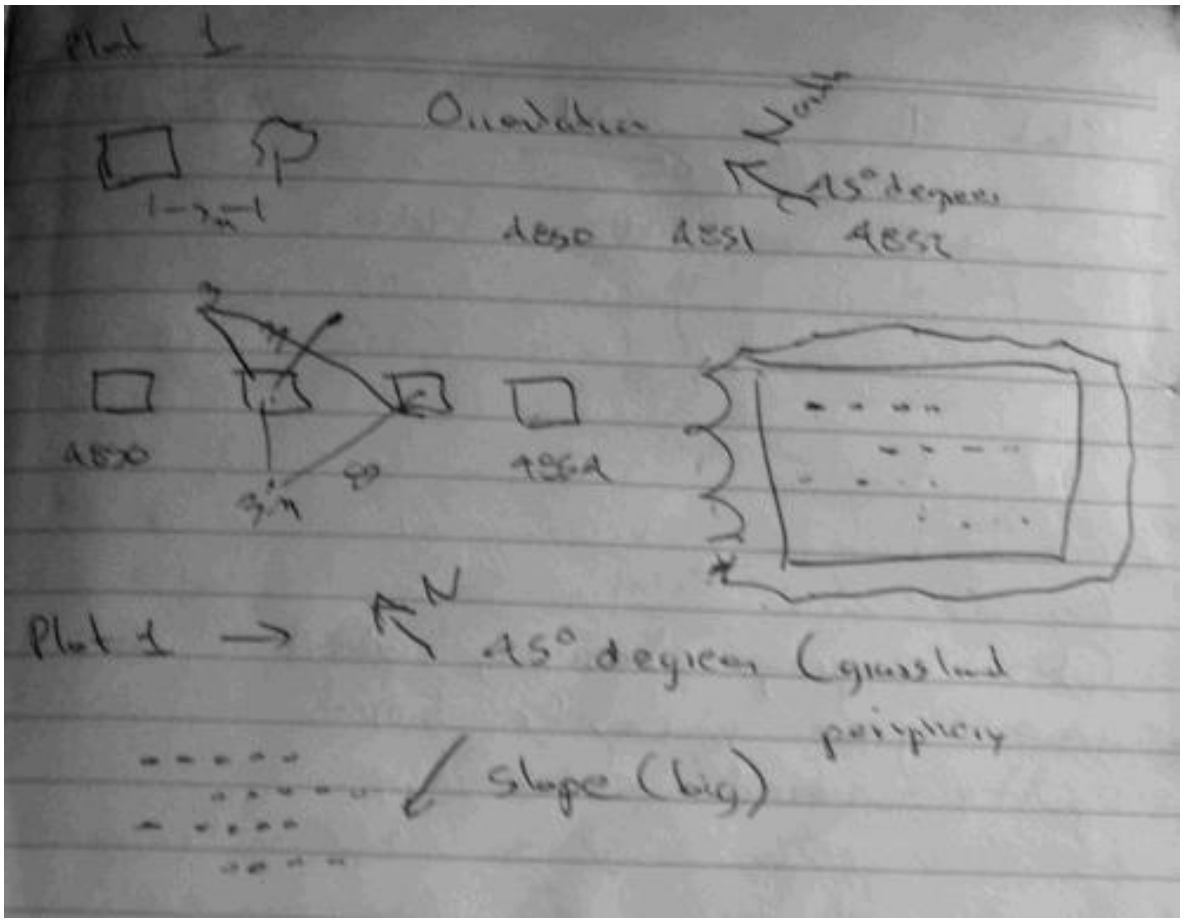
In David's case he brings the forest into the lab when he recreates it on the computer. Seed dispersal is simplified, the entire process can be moved to anywhere with a computer and a process that took years can be recreated in a matter of minutes. In order to produce results that are generalisable, an integral part of scientific knowledge, the forest simulations attempt to take into account all relevant events that take place in the real environment. However social actions and human elements are completely absent, only seed dispersal processes such as wind and primate movement are taken into account. This scientific knowledge space does not take into account the influence that humans have on the forest. All the data that is taken from the forest to the laboratory is focused on processes of nature, not on social ones. As the data is moved from the forest setting to the computer, the information becomes more disassociated from context, even as it begins to describe the forest as a whole.

This project is almost completely reliant on past researchers and current field assistants. Data collected by other research projects is brought together. While each of them focuses on one aspect of the forest, this project attempts to bring them together in order to provide an overarching explanation of how seed dispersal is carried out within the forest. Data that has been collected by past researchers must be adapted to the standards necessary for this project through interaction with the forest. Data about the number of seeds in a trap must be combined with observations of where the seed traps are in relation to the trees and landscape. Rather than collecting new data, old data is re-examined and combined to provide a new interpretation and a new representation of the forest. This is the project most reliant on technology. All of the past data is collected from the computers it is stored in at a foreign university. Then the data is interpreted through a computer program to produce a simulation of how the forest works. To produce this sort of representation requires a highly computer literate individual with an extensive knowledge of mathematics who had access to programmes that are mostly academic in nature. Data from a range of sources is combined to form a coherent picture of the forest.

Before arriving at the field station, David had already developed a collection of knowledge about the forest and how it functions. As with all people coming to the forest from a university, much of this knowledge was from academic writings that the researcher has used to get a sense of their chosen area of interest. This knowledge is on the most part general knowledge that could be applied to any forest, or any instance of the species or process under study. In this case David had acquired knowledge of how to construct computer simulations, the ways in which seeds disperse in a forest and some understanding of the basic behaviours of the Putty Nose monkey, which was the main monkey that data had been collected for. In addition to general academic information, David also had access to five years of seed trap data. Seed traps have been set up in six locations in the forest and information about the seeds has been collected weekly for the past five years. This information includes the seed trap number, number and type of seeds caught in the trap. Using both previous academic attempts to create computer simulations of seed dispersal and this data, David was able, before ever having visited Ngel Nyaki, to produce a rudimentary representation of seed dispersal. During field work in the forest itself, through interaction with other people in the forest as well as with the forest itself, his academic knowledge was altered and added to in a way that caused how the forest was represented to change and adapt. In order to usefully visualise the forest as a whole, computer simulations attempt to simplify various processes that occur in order to

provide a description of the forest that can be easily comprehended. This requires collecting data that is seen as relevant, interpreting this data and creating logarithms that are able to replicate the collected data in order to explain past forest development and predict future development. Even with the raw data, some interaction with the forest was necessary to get properly understand and analyse what that data represented.

This project relied on a transfer of knowledge between researcher and field assistant. In order to make the seed trap information more useful for his own project, it was necessary for David to collect additional information about their set-up and how information had been collected in the past. All the previously collected data had to be given a specific context so it could be properly understood. At that point it becomes possible to remove the data from local context and use it to make a general explanation of the workings of montane forest seed dispersal. In order to achieve this recontextualisation, it is necessary to access the knowledge of the field assistants about the forest and past research. At the same time as he included their knowledge in the project, David also transferred knowledge to the field assistants. As the project progressed it began to clarify the relation of the forest to the seed traps and why collecting all the seed data was important. When collecting the seed trap data before becoming involved in this project the field assistants were not able to give a reason as to what the larger purpose of the seed collection. However during this project it became clearer to them how collecting seeds over a long period of time would be useful to conserving the forest as a whole. Through participation in a project that brings context back to data that had previously be decontextualised the field assistants gained a more clear understanding of what the scientific process was attempting to achieve.



Picture 5: Notes providing geometric information about tree location.

The local knowledge of his field assistants Ali and Nassaar was vital to David's data collection. Ali had been collecting the seed data from the traps for five years, since they were first put in place, which allowed him to provide insights into any discrepancies that were found in the data found. The majority of these involved variations in how seeds were identified on the data sheets, a common issue when so many of the seeds were unidentified. In one case the same seed was listed under three different names; one a generic unknown with a number, one referring to a description of the berry and the last a description of the tree itself. With this information it was possible to combine all of the names into one, providing more useful and accurate data. This was also necessary when multiple spellings were used for the same type of tree. Both field assistants had spent a significant amount of time learning the scientific names of trees and were extremely familiar with the forest itself. When a certain type of seed was found in the traps, the assistants were able to point out all nearby trees of the same type, determine if they were old enough to have produced the seeds, and then collect location and size data. Additionally, the field assistants work on other projects at the field station so they are able to provide information about multiple aspects of the forest, as well as

being able to recommend other project data that might be useful. Nassaar had also been collecting data on the behaviour of Putty Nose monkeys for another project that was being run at the field station. He took David along as he collected data, and explained the locations of the monkeys within the forest and their general behaviour, something that was only possible due to his extended observation of them. The ways in which science are practised are influenced by how local field assistants choose to interact with the scientific method and this controls what knowledge is ultimately produced.

Attempts to model a complex forest system such as seed dispersal are necessarily going to be simplified and removed from the context of the forest. In order to provide useful information they have to be applicable to other forests outside of Ngel Nyaki. Multiple forms of data are included to create the model, primate behaviour, known seed dispersal actions. It is heavily reliant on the international scientific knowledge base that has determined what is relevant in seed dispersal and has created various ways of modelling systems. A functioning and accurate model allows for management advice regarding regeneration of montane forest. Primates are not the main focus of this research, rather they are one aspect of the system within the forest that moves seeds and controls forest expansion and growth. The behaviour of animals is assumed to be constant in different forests and specifically local factors at work on the dispersal of seeds are limited in order to make the model applicable on a larger scale. The larger number of factors included in the model, the fewer additional forests the model will be applicable to. In order to try and make the model more expansive it was necessary for David to first increase the amount of local contextual information available to him by determining which trees were involved in the seed trap experiments and where they were located in relation to the traps. This allowed him to focus on specific trees and describe them only by species, height and location to the various seed traps. By making each tree describable by a series of numbers it was then possible to transform them into data that could be fed into the model. By deciding which aspects of the forest are the most relevant to seed dispersal the researcher has an influence on the final representation of the forest. If the model was designed around a non-scientific paradigm, or around the actions of humans, then it would look quite different. The way in which a researcher decides to simplify the forest affects how it is represented.

The laboratory in this project ends up being completely artificial, created in a computer. The data collected within the forest is stripped of context in order to produce a model that could

be of any montane forest and can be programmed to describe one of varying size and with varying primate populations. As with completely abstracting the elements of the forest away from their context to form an understandable and simplified model of function and behaviour it is also necessary to remove any unstudied elements from the model. If the data was not collected then it does not exist within the model of the forest. Data still requires context to be useful, but after the project the data created should be useable as a representative of a forest seed dispersal system without needing the original forest. Data collected about primates is used to represent the primates only as they relate to seeds, not as themselves. Using the same data as other projects this project formed different conclusions and formed a different picture of the nature of the forest.

Conclusion

Primates are involved in each of these research projects, although they are used differently in each one. In two projects they are the main focus of the project which are designed specifically to give information about the behaviour of the primates in question. This information is gathered differently in each case, one using direct observation and one using indirect. The differing methods lead to viewing the primates in different ways. The three Tantalus are seen as individuals, are named, and their behaviours are well known. Although their cage lies within the forest boundaries, it is separated, not only by the walls of the cage, but by the behaviour of humans. People go to the cage to visit the Tantalus, ascribe human traits to them and feed them. The chimpanzees on the other hand are part of the forest. They are rarely seen, individuals are not readily identifiable and the information collected about them relates exclusively to their impact on the forest, what they build, eat or leave behind. Primates are used in the seed dispersal research but they are not the main focus. Instead they are viewed only as being part of a process, and they are important only insofar as they participate in the dispersal of seeds. Individuals are irrelevant as they are reduced within the modelling program to blobs representing groups of primates as they move through the artificially created forest. Their numbers can be changed at will by anyone using the program, and they are merely recognised as a part of the system whose important behaviour can be generalised and recreated. The construction of each project helps to construct the way in which primates are represented, which in turn constructs the representation of the forest as a whole.

The variations in laboratory caused different final products to be produced by each project. The expected product of the caged Tantalus research is a plan for three specific individuals, this would impact the forest only by their presence or absence. The chimpanzee project provides previously unknown knowledge about the nature of a little known species and helps to describe their place in the forest. Finally the seed dispersal project strives to describe an entire forest process by giving a simplified explanation using data from controlled experiments, observational data and academic knowledge. All three provide some benefits for forest conservation, the ultimate goal of the research station. Caged Tantalus provide an opportunity for interaction with primates that is otherwise unavailable to local people which allows for education, chimpanzee numbers can be used as measure to determine the success of conservation programs and help to guide conservation planning in the future and the seed dispersal simulation can also be used to guide conservation efforts by providing possible ways to increase forest growth and regeneration.

Depending on the design of the project, field assistants are placed in different places within the scientific knowledge system. Data collection can be done in a number of ways that cause the field assistants to view primates as an object of research and intrinsic value or simply as something that can be counted and measured. Either way it is a different view than that of a hunter or farmer. By viewing the interrelations between projects and their relation to the field station as a whole, and how a simple data collection task relates to the forest, the forest is presented in a new way. Those people I met who had not interacted with the field station did not view the primates as having a role in the growth of the forest, whereas those who had observed and recorded their feeding and defecation looked at the relationship in a new way. Which aspects of the scientific process they are involved with has an influence on the ability of the scientific paradigm to shape their view of nature, and also how much they are able to influence the scientific knowledge created by the project.

A specific demonstration of the differences in perception is the way in which primates are seen by those groups involved in the management and protection of the reserve. As a part of the forest, the primates are seen alternately as common pests that are becoming an increasing problem as the forest regenerates, a necessary part of the growth cycle of trees or as something worth preserving in and of themselves. Three main groups interact with the primates; international scientific researchers, non-local but Nigerian employees of a conservation organisation and people residing near the forest. A lack of cohesiveness in

perspective on forest issues such as primates leads to different final aims regarding conservation and also to various types of conflict. The differences in how primates are viewed by the groups involved in conservation are reflective of larger perceptions of the meaning of the forest. Each of the forest purposes; research, conservation or social and economic development is expressed in the varying treatment and valuation of primates. In order to create a fully functional network that is supported by all those involved attempts must be made to create specific issues that those involved can agree are important.

Chapter 4. Local Effects of a Scientific Paradigm

In this chapter I discuss other actants that are involved in the conservation project outside of the scientific research itself. I begin by introducing those who work directly with the NMFP and then discuss how different levels of use of the scientific paradigm affects the views of each group. The way in which each group views the purpose of the reserve and the value of primates within the reserve reflects their different types of knowledge. Having argued that there are different sets of interests and knowledge within the actor-network of the conservation project I continue by discussing how this has led to conflicts of interest, and how these are being resolved. The NMFP is made up of a variety of different groups with different interests. The previous chapter looked at the work of researchers and the types of science they practise. In this chapter I introduce two groups, the NCF, a Nigerian conservation organisation, and the field assistants that I observed at the field station. Each of these groups has their own interests and come from very different situations. I explore how these differences lead to different views on how the field station and reserve should work. The NMFP is constructed as an object around its aim, scientific conservation. The different ways in which its purpose is viewed by different groups and the different ways in which the nature-culture divide are viewed can lead to the object functioning differently depending on who it is interacting with. Using primates as an example of an aspect of the forest, the entirety which is seen as the domain of the NMFP, I will discuss how science produces a particular outlook for the NMFP that affects its interaction with outside groups. The focus on scientific research and conservation is not equally shared among everyone involved in the forest, including some working within the NMFP itself and this changes how the NMFP functions, no matter how it was originally constructed.

NCF

The Nigerian Conservation Association (NCF) is strongly associated with the NMFP. They work together in both the direct management of the reserve and education about conservation. The four aims that the NMFP was created around, combining scientific research with education, facilitating Nigerian montane forest research, involving the community in forest management and working in other ways in the community, are similar to those of the NCF.

The Nigerian Conservation Foundation was established in 1980 and is the largest environmental NGO in Nigeria[11]. The major goals of the NCF are; saving endangered species, protecting endangered habitat, realising the value of biodiversity in order to reduce poverty and addressing global threats such as pollution, deforestation and climate change. The mission statement of the NCF is:

> *To preserve a full range of Nigeria's biodiversity which include species, ecosystems and genetic biodiversity; to promote the sustainable use of natural resources for the benefit of present and future generations; and to advocate actions that minimise pollution and wasteful utilisation of renewable resources.*

The NCF has been working in the area alongside the NMFP in a variety of ways. They provide the patrollers who protect the reserve, although those are to some extent managed by the NMFP itself. The manager of the NCF provides a link with national resources, and legal backing should any problems arrive with the reserve. Additionally the NCF provides education for the local area, providing help in business and adult education alongside conservation education. The ways in which the NCF interacts with NMFP are related to how it sees it own purpose. By focusing on biodiversity conservation, the NCF is aligned with the goals of the NMFP and this is reflected in the way the two interact.

The ways in which the official goals of the NCF are addressed are through conservation education, policy advocacy and conservation action. Within Taraba State the NCF has produced management plans and provided technical and financial assistance for protection and management of Gashaka-Gumti National Park and has been involved in a Participatory Forest Management Project at Ngel Nyaki. The program at Ngel Nyaki focuses on local education as well as physical protection of the forest. To this end patrollers are employed to enforce the laws regarding the use of forest resources, to report infractions and to bring cases to the attention of the police and courts. Additionally, the NCF has instituted a number of educational and social development programs in order to encourage local support of the reserve. The manager of Ngel Nyaki employed by the NCF[12] explained the importance and purpose of the NCF and NMFP presence:

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[11] http://www.ncfnigeria.org/

[12] The manager lived within Yelwa village while managing the NCF. He held a university degree and originated from outside of Taraba State.

"We deal with people. We try to maybe reduce their activities which are detrimental or which are trying to disturb or interrupt the ecosystem of the reserve, the wild animals and the plants. We know that the wild animals also live like we human beings, they have a home to be and they have to, in the environment, they have to get an environment that is not disturbed or interrupted so that they can exist."

"Where people intrude or encroach into the place without permission, without legal, we stop them from doing their activities that are not in order with the aims and objectives of the reserve. So actually what we do is, we do enforcement. We have things to measure, ways of protecting the forest. Firstly we enlighten the community, so that they know the importance of the plants and animals being preserved in this very location. And secondly, we enforce law on people who misbehave or offend us. People who deliberately want to disobey this order. They know that it is not right for them to get into the reserve and maybe do the things they do, maybe hunt the wild animals, or remove the plants, or farm, or graze, they go in illegally. So such ones that go in and do wrong things, we try to enforce law on them ."

Legal intervention is a last resort as far as the NCF is concerned. Although they can have encroachers arrested, taken to court and even prison if necessary, their preferred methods of intervention are diplomacy and education. They consider that if those who would enter the forest illegally can be taught the reasoning behind maintaining the reservation and agreement can be reached on forest usage then in the long term the forest will better protected. Those who may have been encroachers in the past will be persuaded to encourage others to protect the forest in the future.

Both the NMFP and the NCF favour education programmes for the local people in order for them to participate fully in the conservation of the Ngel Nyaki Forest Reserve. The programmes created by the NCF focus on educating specific groups such as women, school children or farmers in ways that are tailored specifically towards each group. The majority of the education is done through group meetings which are designed either to teach a certain skill, for instance beekeeping, or impart certain knowledge, for example the names of forest plants and animals. Education from the NMFP comes through the training and use of field assistants on research projects. As field assistants are also local residents, they are able to pass on information and knowledge learned while working to other people from the local area.

Picture 6: Educational conservation cartoon from the NCF magazine for children.

Picture 7: Educational poster of animals and conservation terms.

The NCF and NMFP establish themselves in a position of authority over the forest and the people who live in the surrounding areas. According to the aims of the two organisations the keys to conservation are education and scientific research. By establishing scientific research within areas that are deemed to be in ecological danger the need for scientific solutions to ecological problems is confirmed. Researchers gain control of the data about the forest and are thereby in a position to educate other people on how the forest functions and how it must be controlled.

Field Assistants

Four main field assistants participated in the projects I studied. Wasulu and Kamaal work together on the chimp project. Wasulu is one of the few field assistants who is not from Yelwa. A Fulani in his mid-twenties, he is less reliant on the field station job than those from the village due to an additional source of wealth from his cows. He continues to work at the field station because he finds the work interesting and enjoys learning about the forest and scientific practice. He has been educated to high school levels through one of the Fulani mobile schools. Kamaal is in his thirties, a lifelong resident of Yelwa. His work at the field station has allowed him to build his own house, something his mother said would not have been possible otherwise. He has a primary school education. Nassaar and Ali worked on the seed dispersal project in addition to their other projects. Both are long term employees who have participated in a large number of projects and have collected and shared large amounts of knowledge about the forest, both have primary school educations. One of the most proficient English speakers, Nassaar has extensive knowledge of both scientific and local names of the plants and animals in the forest. He also works imputing data from worksheets into the computer so it can be sent back to researchers. Ali has taken courses in computer use making him one of the most computer proficient field assistants. The range of knowledge that Nassaar and Ali have about the field station and forest makes them uniquely able to advise others about what has happened in the forest since the institution of the field station.

With an ideal construction in place, scientific research station and education programmes to spread the ideas of conservation, the NMFP then has to apply its paradigm to its work. This conservation paradigm is applied to varying degrees by those involved and is affected by influences from those outside the paradigm.

There are several local issues that alter how science is practised at the field station. They come into being because of the influence of the field assistants who have not been trained in the scientific method or involved in a culture that puts an emphasis on Western science. The lack of training in the scientific method means the field assistants are not properly prepared to be responsible for collecting data. Before the arrival of scientific thinking, the trees and plants of the forest were known by local names and knowledge of the uses of each were passed through local populations. Herbalists trained and learned the names and medical uses of plants, while the general populous knew which plants were commonly used for food. Under the scientific system used at field station, what a plant or tree can be used for by the local

population is largely irrelevant to data collection and experimentation. Many of the researchers doing their fieldwork are not botanists, and therefore rely on the field assistants to provide them with information about the names of the trees in the forest. These scientific names are something they learned from former researchers and other field assistants. Beyond being categorised and formed into data, the trees no longer have any relevance to the every day lives of anyone forming knowledge about the forest. Plants and trees that are locally known for their uses are now catalogued by field assistants without context as to why they are important.

A major hurdle to the organisation of flora data is the overwhelming number of species that are unidentified according to the international scientific system. The majority of trees and plants in the forest have no scientific name attached to them, leaving them and their seeds unclassifiable by field assistants and researchers. There are current attempts to photograph and preserve the unknown plants and their seeds so they can be identified in the future. However large portions of data that are being collected are useless, without a naming system there is no way for unidentified seeds to be described and the information catalogued. Another problem that this causes is when there is collaboration between different projects at the station. When an unidentified seed or tree is found, it is supposed to be given a specific unknown number which is linked to that seed and the tree it comes from until an appropriate classification can be made. In reality multiple names are given to a single unknown seed, some related to the standard unknown classification system, some created by the person collecting data. Additionally I observed disagreements between pairs of field assistants over the classification of certain seeds. The data that each was recording reflected their own opinions on the correct classification, an issue that would not be known by a researcher looking at the raw data. Data that may be collected in a scientifically appropriate way may no longer be so when it is added to a larger collection of knowledge. In practise, local biological classification systems have been found to be quite similar to western systems (Zent, 2009:25). By exploring the local naming of flora, it might be possible to use local knowledge to fill gaps in the scientific naming system. As well as involving local people in the forest management and increasing interaction between the local community and the research station, it would increase the usability of data that is currently being listed as unknown. Additionally, exploring the modes of classification used locally could provide interesting information about how people interact with the forest, and that could in turn provide useful information about the local environment that could help with future conservation efforts.

English comprehension is limited among the field assistants. The use of scientific language by researchers instead of common English makes communication even more difficult. One field assistant had been doing primate observation alone for several months, recording each behaviour onto a pre-prepared worksheet. The worksheet listed six behaviours, of these the field assistant was unaware of the meaning of two of the words listed on the sheet, locomotion and foraging. Both of these words were scientific terms for actions that could also have been described using common English words that he did know. Due to this oversight there were months of data that were inaccurate, something the researcher using the data was unaware of. The problem of comprehension is exacerbated during the rainy season as few researchers are present at the field station to provide help and there are long periods of time where data cannot be collected due to heavy fog. During my time at the station there was a period of more than two weeks when no data could be collected, which increased the likelihood that a field assistant would forget the definitions of words that he would have no other exposure to.

The field assistants that I spoke to understood how to perform the scientific techniques they were assigned. However whether they understood the basis behind the techniques depended greatly on the researcher who assigned each task. Most researchers did not fully explain the purpose behind their research, leaving the main collectors of data to be unaware of the science behind their work. As the field assistants perform most of their work alone, without supervision or extensive contact with the researcher, any problems that develop in the field have to be solved by a person who is not in possession of all the background information. Additionally the field assistants never see the results or conclusions that are created from the data they have collected. Academic papers are written and are available at the field station, but they are written in academic language and according to the academic standard for biological scientific papers which makes them difficult for anyone outside of the field to understand. The field assistants with primary school educations and poor English language skills are effectively blocked from seeing the conclusions.

Those people responsible for the major transfer of scientific knowledge, the field assistants, are not fully invested in the scientific system. They are still resident in their local system of knowledge. When the basis of the scientific knowledge at the station is being created by those not invested in the scientific system it increases the possibility that the scientific knowledge

system the research station bases its production of work on is not entirely scientific, and has instead been altered by local knowledge systems.

Field assistants who work with the research station collect scientific data but also work as mediaries between the people of the village and the field station. For my interviews in the village I relied on a field assistant, Yasiin, to translate my interviews with those people who didn't speak English and also to introduce me to the variety of people who live in the village. Yasiin is in his mid twenties, has graduated high school and is fluent in at least five languages including English, Fulfulde and Hausa. He was recruited as a field assistant on my behalf due to his language abilities and his good relations with much of the village, in large part due to his work as a teacher and shop worker. He and his family are long term residents of the village. Before becoming a field assistant his only previous interactions with the field station were his close friendship with a long-term field assistant and working at the nursery school that was built by the NMFP. As well as being a fount of local knowledge, Yasiin also served as a bridge between the field station and the village. While working as a field assistant his interaction with the forest, his interaction with the field station and his relation to others within the village all changed.

While we were working together Yasiin began to visit the field station and become involved in discussions about it. During one walk to the village he and I had a discussion about the reasons behind wanting to conserve primates. The ways in which primates interact with the rest of the forest and their participation in seed dispersal was information that he had not previously been exposed to. By being involved in daily discussions and interviews on the forest and the reserve he developed a greater understanding of how different people related to the NMFP. This in turn led to him developing his own questions about the forest, and increased his enthusiasm about the politics of the village. His presence at the field station, and his association with a foreigner placed him in situations that would otherwise not have been possible. When a number of politicians came to the field station to address forest boundary issues Yasiin was first of all able to attend, something that would not have occurred without his association with the field station, even high ranking members of the village complained they had not been involved. Secondly he was placed in a position to get close to the politicians and hear conversations that occurred between them and researchers at the field station. Finally he wrote up and analysed what had occurred in order to compare with me what he had seen occurring, something that he would not have been likely to do otherwise.

By being involved in the collection of data on a subject, in this case the way in which people of the village view the field station, field assistants develop new knowledge and then begin to use this knowledge in their every day interactions with the other people they associate with.

Those who work as field assistants are the main link between scientists and local people. They possess knowledge from both groups and they to some extent control interaction between the two groups. Due to proximity alone, field assistants are usually the ones who talk to and make friends with researchers, thereby giving them control over who in the village they visit and talk with. While Yasiin made a special effort for me to meet as wide a variety of people as possible, this is not the case with other field assistants. Rather every visitor tends to be introduced to the same group of people, a group that does not represent the diversity of the village. Field assistants' control over the interaction between scientists and other local people allows them to maintain significant control of the perceptions of both the local area for the scientists and the field station for the local residents.

Purpose of the Reserve and the Field Station

While the NMFP has a stated purpose and clear set of aims, it does not function that simply in reality. The forest around which the NMFP was constructed is viewed differently by different groups. Those who do not share the scientific conservation paradigm regard the NMFP as different than it was originally constructed to be.

The forest at Ngel Nyaki is perceived differently by the different groups who interact with it. There is no clear unifying purpose for the reserve among those involved in its conservation. There is some overlap of opinion between the groups, as well as variation within each group. I asked residents of Yelwa, researchers at the field station and members of the NCF stationed in Yelwa a series of questions regarding their views on the reserve. In this section I will discuss their opinions and the reasons for the variation between their views on the importance of the forest, the purpose of the NMFP and of conservation itself.

Purpose for NMFP researchers

Researchers who have come from the academic environment of universities focus on the importance of Ngel Nyaki as an example of a location that provides unique opportunities for study and research. Primate and bird species are relatively easy to locate and collect data from, and there are a wide variety of plant and tree species.

"The NMFP is a conservation tool, used to protect the rare montane forest environment. It also serves as a place of employment for the local community and allows students and researchers to conduct fieldwork"

"Science is important, the field station gives the people, the children, opportunities they would have if they lived somewhere more developed, like Abuja. It gives them a respect for science."

There is a clear interest in the scientific benefits of the reserve for visiting researchers. As very few of the researchers I spoke to know any information about the history of the region or the benefits lost by those forced out of the forest, economics are not highly valued in relation to the forest. Conservation is valued, both for future research opportunities and due to the importance placed on the maintenance of biodiversity, something that is highly valued amongst those involved in the biological sciences.

Purpose for the NCF

The NCF (Nigerian Conservation Foundation) has a clear position on the purpose of the reserve and their hopes for the future of the forest. Both the organisation's mission statement and its representatives located in Yelwa are concerned with both conservation and economic development of the local community, and using scientific research to help reach these goals.

"NCF pursues the conservation of nature and its resources with the aim of improving the quality of human life both the present and the future by: Preserving the full range of Nigeria's Biodiversity which include species, ecosystems and genetic Biodiversity; Promoting sustainable use of natural resources for the benefit of the present and future generations; and advocating actions that minimize pollution and wasteful utilization of renewable resources."[13]

The NCF manager for Ngel Nyaki summed up the position of the NCF on the purpose of the reserve:

"The most important reason for reserving this place is for research purposes, for future research because the world is developing. As schools are opening and younger generations are going to school they will have this place to make research, because land is not being multiplied, but human beings are multiplying, so land is becoming scarce. So this reserve we

[13] http//www.ncfnigeria.org/

have to protect it or else as more people are increasing in the communities, they will enter the place to farm, graze, so these natural biological existings will be finished. So that's why we are protecting and preserving them. That's the importance."

As a conservation NGO, the NCF focuses on the protection of biodiversity within the reserve. Additionally they are interested in promoting scientific research and addressing economic and social concerns. Members of the NCF stationed in Yelwa are not directly affected by the economic impacts of the reserve as they are from other parts of Nigeria. They are also not directly involved in scientific research. Due to their conservation strategies being focused on promoting both scientific methods and economic benefits for local residents, the people of the NCF share values and knowledge with both NMFP researchers and the residents of Yelwa.

How purpose differs between field assistants and other locals

Those residents of Yelwa who were not directly employed by the NMFP or NCF provided two main answers regarding the purpose of the reserve, conservation and village improvement. There was also a large minority who could not name any purpose for the reserve. These included those who wished to use it for grazing and some who felt that it did not concern them.

"The reserve does not affect me in any way. I just concentrate on my business. I have no idea what goes on up there or what its purpose is. But more people being employed does mean that more people can spend money here, so I like that." - local businessman[14]

People who ran their own businesses, and so were not looking to the reserve for employment, were on the whole not interested in the reserve unless they were old enough to have been removed from the forest or had children who were in need of employment. Additionally, those who were newly arrived to the village did not usually have information or strong opinions about the status of the reserve. The majority of people however, stated that the purpose of the reserve was a combination of conservation and providing aid to the poor people of the village.

"It is important to protect the forest and the animals. We did not know the importance of the forest before the reserve and we were destroying it. Now it can be preserved for our children."[15]

[14] Similar opinions expressed by various shop owners - all male, in their twenties and thirties

"We really support the project. It has built the nursery school so our children can be educated. It has also brought employment. Before the young men had nothing to do, now they can get jobs and support us. Even those who don't work benefit from the reserve because there is more money in the village."[16]

When referring to the importance of conservation, people living in the village consistently gave the same response, that it was important to protect the forest and animals. Herbalists and teachers were able to give specific reasons as to why it was important, for the maintenance of medicinal plants and trees or because the forest is rare and is therefore valuable to researchers. The majority of other villagers however stated that conservation was important because that is what they had been told or because the reserve brought economic benefits to the village. When asked about the conservation work that is occurring at the reserve, only construction of buildings and forest patrolling were mentioned, the two activities that directly affect the lives of the villagers through either employment or being restricted from entering the forest. Among those village residents not employed by the reserve, only one person, one of the few who visited the forest consistently, was aware of any specific conservation or research projects that had taken place at the reserve.

"They study the trees, plants and animals. When some animals eat the fruits and defecate there is germination, when others do the same there is no germination. They look at why there is this difference as germination is vital for forest growth."[17]

The amount of information possessed by residents of Yelwa about what goes on at the field station is severely limited. People were aware of construction projects due to the necessity of all building supplies passing through the village. Otherwise they relied on employees of the field station and education programmes from the NCF to share information. Due to this, the main areas of interest for the people of Yelwa are economic support of the village and conservation of the forest for future generations.

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[15] Farmer. Male, approx. fifty.

[16] Males, all over fifty. Supported economically by their children and small farms.

[17] Male, forties, primary school teacher. English speaker.

Picture 8: Construction projects were well recognised due to the quantity of supplies passing through the village.

The Value of Primates

Primates and their conservation have a variety of values to different people. These include ecological, economic, moral and scientific value (Hill, 2002:1184). Although primates may have worth, this is often combined with costs associated with living alongside them. Local residents stated that primates were important and needed to be conserved, as had been told to them by educators from the NCF, but there was little evidence that the reasoning behind this point of view was being transmitted. Almost none of the ecological and scientific value of primate conservation had been explained to villagers. By including this information in future education it may be possible to demonstrate that the value of primates outweighs the potential costs of maintaining their habitat and numbers. This would be most useful at times when the economic benefits of the reserve are limited or when damage wreaked by primates on farms is especially high.

Value for NMFP Researchers

Value of primates for the researchers is varied combined with official NMFP policy, also have opinions based around their personal interest in primate research, they had a choice in their area of study, also impacted by the novelty of primates, most come from places where monkeys and apes are not common, think they're important for their research, for biodiversity, and as individuals. Some researchers said they were not at all interested in humanity and how the reserve would affect the people who lived nearby. Instead they were concerned only about the primates, considering them to be valuable. Studies that were conducted on primates focused either on primate behaviour and habitat or looked at the monkeys as tools to understanding the development and restoration of the forest. In the second case, primates were just a tool, a set of data to be collected. This research wasn't done for the benefit of the primates, but in order to understand a process of which they were a part. These researchers considered the value of the primates to lie in their ecological and scientific value, while others considered their moral value also.

Value for NCF

Members of the NCF working in Ngel Nyaki consider primates important enough to be conserved for their own worth. They are interested in maintaining a variation of species as the NCF views biodiversity as an important goal of conservation. Within Tortoise, the conservation magazine given to schools involved in the NCF's conservation club, there are several attempts to encourage protection of animals for their inherent value. Little specific information is given about the usefulness of animals to humans or for nature in general, but conservation of them is still encouraged. This same philosophy is applied to the primates at Ngel Nyaki. The official policy is the complete protection of primates with a limited view on the impact on human populations. Official programmes do try and provide alternate methods for procuring meat such as rabbit rearing to balance removing monkey meat as a free local food source. However when competition occurs between primates and humans, they side with the primates. When local farms are raided by primates from the forest and crops are destroyed, this is blamed by the NCF on farmers ignoring the policy of farms not being within a certain area of the reserve.

> *"People are infringing on where the monkeys live, people are the problem, not the wildlife. How would you react if I came and started living in your house?" – NCF manager*

Patrollers are hired to stop hunting, farming and grazing in the reserve, partly to prevent trees and plants from being destroyed, but also to maintain the various animals in the forest. As most of the animals of the forest have been driven to extinction in the past, this generally refers to primates and birds. One of the specific arguments used by the grazers as to why they should be allowed to enter the reserve is that they don't disturb the wildlife, clearly the message has been put out that preventing disturbance of the primates is a main purpose of the reserve, and a priority for the NCF. Farmers have been told that they are no longer allowed to kill primates that raid their crops, and hunters have received the same ban on killing primates for food. However, all the patrollers do not seem to have taken the primate conservation preached by their employers to heart.

> *"I can show you all sorts of traps set by the patrollers. They are the main ones who kill animals in the forest."*[18]

Some hunting is allowed to go on in the forest, against the official government policy. Clearly some enforcement is taking place, as when a hunter sees someone from the project they turn and run. Also patrollers will return with hunters and illegally hunted animals in order to prosecute them. However there are large numbers of traps set throughout the forest, especially in areas that patrollers rarely visit. Other people told me that the patrollers were aware of the identity of some of the most prolific hunters, who sold primate meat at local markets, but would not prosecute him due to his relation to employees at the reserve. People at different levels of the NCF all share the general outlook that monkeys should be protected, but they act upon this opinion to different extents.

Varied Value for Local Residents

There are a variety of often contradictory ways in which local residents view primates. They are seen as both useless and important, as pests or as a food source, or they are seen as completely irrelevant. The purpose of the reserve is generally understood to be to protect the forest, specifically the important trees and the wildlife. Some, mostly older people involved in either farming or herbalism, will refer to the importance of trees for creating medicines. Almost everyone will mention monkeys. Aside from those who work at the reserve and hunters, there is generally no knowledge of the different types of primate in the forest, only

[18] Grazer living at the boundary of the reserve. Aged in his seventies.

the word wandu (covering both monkeys and apes) is used. Among those who do differentiate between types, the reserve workers use the English names (baboon, tantalus, chimp etc.,) while others use local names[19]. When Oliver was interviewing village farmers to determine primate behaviour in farm raiding, most village residents struggled to differentiate between the different species. Often the only distinction was big or small. Many people that were questioned appeared frustrated when asked to distinguish between species and said that it didn't matter what type of monkey it was, they just wanted to get rid of them.

Those from Yelwa who view primates as valuable focus on their economic value. The value that the researchers and NCF put on primates translates into value for the villagers. If primates are protected then it will encourage more researchers, government officials and tourists to come to the area and invest. Those who I spoke to did not know why primates were important to the conservation of the forest, but they were aware that most researchers were interested in studying them. Economics was also mentioned as a negative impact of the ban on primate hunting. Meat was no longer available to be eaten, and profit was no longer being made by selling primates on to other villages. Additionally, the increase in primate numbers due to conservation increased the amount of damage they did to local crops. During times when there are limited supplies of fruit in the forest various species of primate conduct raids on village farms. As residents are no longer allowed to kill them, their boldness and incursions have increased. They are tolerated only as long as there are clear economic benefits to following the laws on primate hunting. Even among those residents who saw an economic benefit to the primates, they still considered them fundamentally useless for anything but meat and did not understand why anyone would come from another country specifically to study them.

Knowledge and Local Issues

Three issues were consistently mentioned to me as being of concern to the residents of Yelwa: who controls the NMFP, how consistently bans on entering the forest are being enforced and the effect of increased primate numbers on farmers. Each of these issues is aggravated by underlying problems in the region. Lack of access to resources is a generalised problem, there are limited quantities of land, water, firewood, meat and medicines.

[19] Baboon – Doru
Tantalus – Nyadu
Chimp – Biri mai ganga.

Unemployment is widespread throughout the village, as is illiteracy. Although agro-pastoral conflict has not become violent in the immediate vicinity, there are residents of the village who have fled the conflict on other parts of the plateau and there are tensions evident between some villagers and the grazers. Both control over the NMFP and people illegally entering the reserve with their cattle involve conflict between clans or tribes and are aggravated by different views on how resources, specifically forest resources, should be utilised and allocated. An increased amount of primate damage to crops causes tension not because of ethnic differences, but due to differences in the value placed on primates. Those involved in creating the reserve and research station have worked to increase primate numbers and this is having an effect on the people in the village. Science influences the NMFP, and it also has an influence on the local community. The paradigm moves outwards and has influences beyond simply forest conservation. These influences can exacerbate pre-existing problems in the region. In this chapter I explain the conflicts and dissect both the reasons behind them and the influence the conservation programmes have on local social relations. I examine the social relations of the field assistants most closely as they are affected directly by both the influence of the field station and the larger context of residing within the local region.

Within the village of Yelwa itself there are eleven clans or tribes represented. Within the village, intra-clan language differences are minimal, to the point that my field assistant was unaware they existed within his father's clan, and the common term 'tribe' is used by English speakers for each of the eleven groups. Inside the village limits the largest of these tribes is the Mambila. However if surrounding areas are taken into account, then the Fulani outnumber the Mambila. A complaint laid by several people to me is that the existence of the NMFP has increased inter-tribal disputes. The two main causes of this are the current problem with grazers remaining within the reserve after everyone else has been removed and also the view that the project itself is controlled by a single tribe.

TRIBE	POPULATION
Mambila	1866
Fulani	304
Hausa	240
Kaka	985
Ndoro	895
Kambu	122
Tigon	67
Panso	44
Jonjo	36
Kilba	76
Kleeti	365

Table 1: Population of Yelwa Village

Control of the NMFP

In an ideal scientific field station the field assistants carrying out the day to day data collection would be the most academically qualified available. Only those best able to collect data in a scientific way, and communicate it to researchers, as well as those with the most knowledge of the forest and its processes would be used. Additionally, the field station would be unaffected by the social and economic problems of the surrounding area, left instead to focus exclusively on the science. In reality there are additional factors at work on the field station. The social context of the region where workers must be drawn from affects which field assistants will be employed and how they will be used. Hiring is decisions are officially made by a panel of elders within the village, but the people I spoke to in the village considered the decisions to be made by people already employed at the station. This creates in their opinion a conflict between the best interests of the field station and the village and those of the people working at the field station.

At the beginning of the NMFP there were two main field assistants, one from each of the two main tribes in Yelwa. When I was conducting my research the number of field assistants was closer to twenty and nearly all of them were from the Mambila tribe, the main tribe in the village. More specifically, the vast majority were members of the same extended family. The original field assistant who was present during my research, the other was housebound after a

serious accident, was closely related to nearly all the other field assistants who were working there. This situation was described to me by a large number of villagers as being a case of one family controlling access to the field station. The most vocal about the problem were men in their twenties, most of whom spoke English well enough that I could speak to them without a translator. One reason for their high level of English skill is that schools in Nigeria are taught in English, and many of these men had graduated from high school with exams in science and geography. They expressed frustration that even with exams, good English skills and knowledge about the forest they were still being excluded from the biggest employer in the region due to bias in the hiring process.

In addition to the agro-pastoral conflict between the farmers and grazers, the NMFP has also aggravated intra-village conflicts. The vast majority of those employed at the field station belong to one tribe, specifically one family[20]. Most have little formal education. People within the village, especially young men, complained that villagers who were secondary-school educated, even those who had studied geography and biology were unable to get jobs at the field station. They attributed this to both a desire for one family to control the field station and also the fear by existing field assistants that they would lose their jobs or at least be demoted to work under the more educated members of the village. The manager of the field station who has influence over hiring, and is from the family that is accused of controlling the field station, explained how he sees the reason behind the current set of employees being from a small homogeneous group.

> *"The skills we look for are if someone can speak and write, we take them to the forest and teach practically. People with big folders of education, people started looking at this job like it's not quite good for them, and if they are educated they think they need an office. There is no office job here. We only look for people who work well. People who come here with their education, then they don't want to go out in the bush. We need people who will work in the bush and work well with people."*

> *"For employment we select between the biggest tribes; the biggest is Mambila, then Kaka, then Fulani. If there are too many Mambila it is becoming tribalism, if there are too many Kaka it is becoming tribalism. So we lay all of these issues in front of our chairman and our elders. We do not pick all from one tribe. Although you find that some are not able to do it*

[20] I identified only six permanent employees who were not part of the family. Two of them were Fulani and three were Kaka . Within the family itself there was one member of a different tribe who was related by marriage and the others were all Mambila.

well, so that is why now you find it is majority Mambila. Because Kaka drink too much and we don't like it. When some drink they are not able to do what is needed to be done and someone may not like the smell of drink, that's a problem. Kakas they kept going back, but most of the Mambilas they are not drinking. So for Fulanis, you try to employ somebody, we always go into the forest, into the bush, in the rainy or the dry season, we also go by maybe 7 or 8 in the morning, and they did not accept it. Now, the project is growing better and we are having better salaries, they are fighting to come."

Salaries for field assistants have risen rapidly since the opening of the field station. Combined with a significant level of unemployment within Yelwa, competition for jobs and dissatisfaction with who is employed are likely to increase. There may be legitimate reasons as to why there is so little tribal and familial variation in the current NMFP employees, but if the situation continues it may cause serious difficulties for the field station. Several people told me that the previous year there had almost been a riot due to frustrations with the employment system. An additional complaint that was levelled against those working at the field station is that people within the village are excluded from accessing the resources of the field station and that the foreign people in charge of the station are kept isolated to prevent local complaints about employment from being heard. There are several computers at the field station and the internet which, although completely unreliable, are the only current computer access available without at least an hour car journey. Opportunities to learn typing, computer software and to use the internet are tightly controlled and limited to those working at the field station. Frustrations that are building between groups within Yelwa threaten to interfere with the research station as the perceived benefits of having a forest reserve are seen to be given exclusively to a small group. One of the main benefits of having a research station is economic. However with one small group controlling all of the economic benefits, including providing food and transportation for visiting researchers, the temptation to engage in illegal hunting or farming within the reserve increases.

A high level of value is placed on scientific knowledge within the research station, and field assistants are relied upon to collect data in a scientific manner. In a traditional laboratory this would lead to those who have been educated in science or possess an otherwise vital set of knowledge about the process being studied to be given preferential treatment in becoming field assistants. Although a high level of scientific knowledge is no longer required in laboratories that focus on highly routinised tasks, it is still valued in laboratories that are less dependent on technology and rote tasks. In this field station science students from the village

and some with extensive knowledge of the forest due to hunting and other activities are not being given preferential treatment. Instead local politics, family interests, economics and perceived ability to work with researchers all take precedence. Which people become field assistants is influenced by more than just ideal scientific practice.

Incursions into the Reserve

As people begin to subscribe to the conservation model provided by the field station then the difference between groups who are included in model and those who are not increases. It also adjusts the economic power of the groups as they compete for the same resource. When those working and living within the reserve were originally moved out of the reserve as part of a national conservation scheme it made it easier for those with cattle to move in and take advantage. The two groups have different ideas about what is important, the forest or their cows, and these differences become more pronounced as the research station encourages the spread of scientific conservation ideals.

Before the restrictions on people entering the forest were enforced there were few reasons for the grazers and farmers in the area around Yelwa to come into conflict. The grazing in the area is seasonal and grazers did not generally encroach on the crops of the farmers due to ample land. Since the research station has been built and enforcement of the excluding of people from the reserve has increased, there have been more opportunities for conflict to occur. Although farmers have been removed almost entirely from the forest, incursions by cows remain common. It was repeatedly expressed to me that the grazing problem was the most likely issue to cause the people of Yelwa to flout the law and return to farming in the Ngel Nyaki forest. The issue is so pressing that government officials came to the reserve in order to try and reduce tensions between the Fulani grazers and the residents of Yelwa. There are disputes between those guarding the reserve and the grazers about whether the boundary of the reserve has been moved. In order to try and mark the boundary, the NCF sprayed herbicide that would kill the grass and provide a clear visual marking. This led to accusations by the Fulani that the herbicide was dangerous to their cows and that the NCF refused to work with them on resolving the border dispute.

Picture 9: Strip of dead grass marking the boundary of the reserve.

Numerous cows and damage caused by them are present well within the reserve as high quality grass is available there at times when grass outside the reserve is scarce. Patrollers remove cows from the reserve and will also arrest the grazers and have them sent to court. Several grazers were arrested prior to my arrival in Nigeria, and were charged with illegally entering the reserve. While I was there they were released by a member of the local government with no further action taken against them. According to those I talked to who are involved in attempts to prosecute those illegally entering the reserve, the grazers are rarely punished due to their political influence and their wealth. That grazers continue to use the reserve for their cows while farmers have been forced to move out of the reserve and onto lower quality land causes resentment among the people in Yelwa. Many negative opinions towards the grazers were expressed to me by people living in the village.

> *"The grazers should get out of the forest, they're bribing government officials so they don't get in trouble, they're paying money so they can stay after we had to leave. If they don't leave then we (farmers) will move back in. We shouldn't have to suffer because the government told us to leave and we did."*

"The Fulani encouraged the project (NMFP) to remove the farmers and keep them away so that they could have it for themselves. No one is doing anything to remove them, they are just letting them have all the land."

"They're trying to destroy the project because they only care about their cows, they're not worried about the effect on the village. All the cows should be burned, that would solve the problem."

"The Fulani are hiring people from Niger to come and kill us. We can't do anything against them as they will have you arrested and no one can afford to get bailed out. They have all the money. They have threatened to kill us. When the people at the reserve were trying to mark the boundary they told them they would kill them."

Those residents of Yelwa that I spoke to who were grazers or were related to grazers were, with the exception of two Fulani Ardos[21], apathetic about the reserve and unconcerned about illegal grazing.

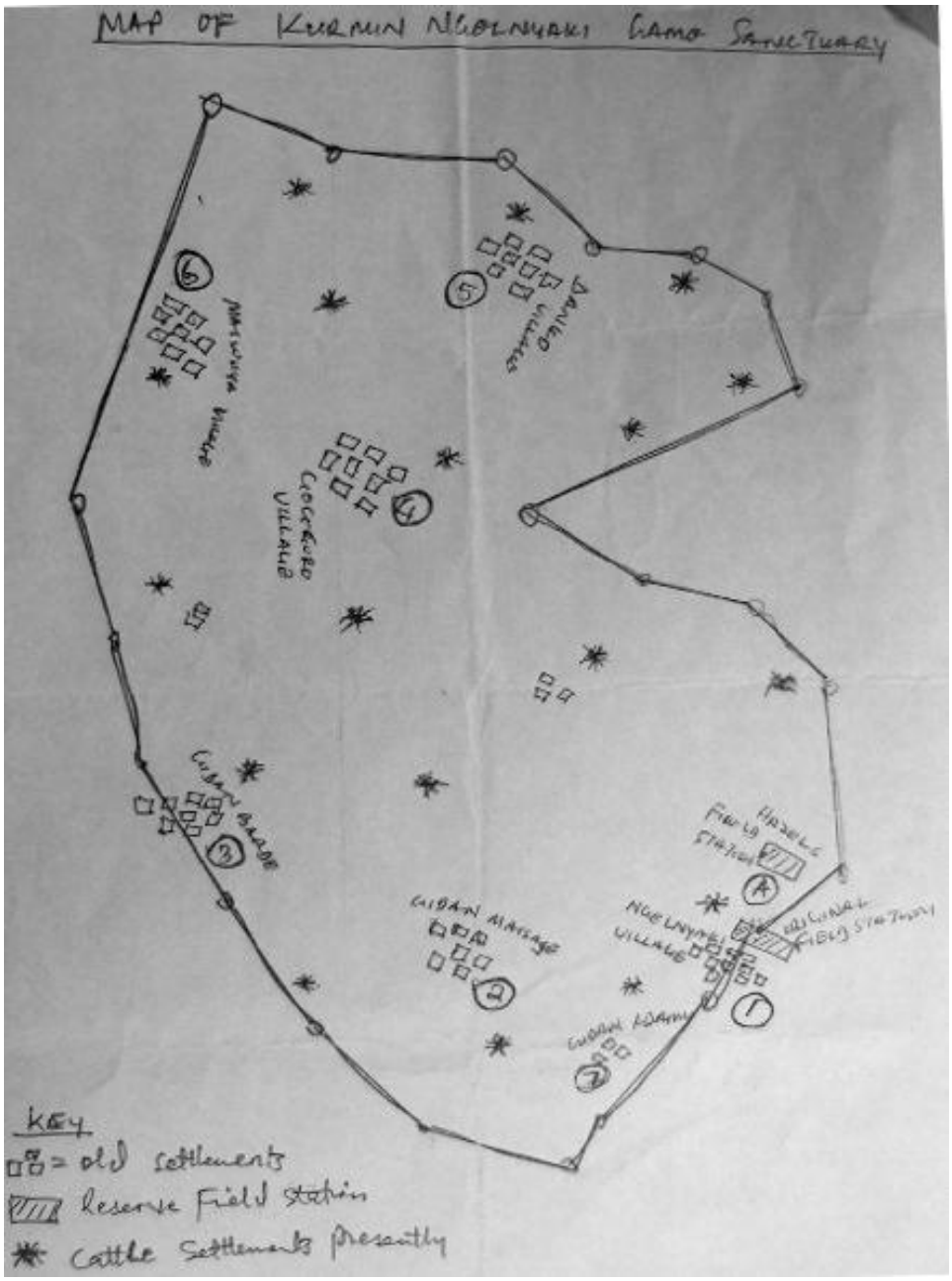
"The people in the village are trying to have us and our cows removed from the forest. We aren't burning or hunting and our cows don't disturb the animals. But suddenly we were ordered to leave, without explanation. All of the benefits of the project go to the village and the people living there, there are no benefits for us."

The people living in Yelwa receive more benefits from the presence of the NMFP than the Fulani grazers and are therefore more heavily invested in its success. Commonly the Fulani, particularly those who own cows, see no benefit at all to the reserve or the presence of scientific researchers and have very few interactions with conservationists and researchers outside of confrontations regarding the removal of cows from the reserve. They also tend to be educated within nomadic schools rather than those that are receiving assistance and educational programmes from the NCF, which means they do not tend to use the same language of conservation that the people of Yelwa do. Prior to the establishment of the reserve and then the construction of the NMFP, grazers, farmers and hunters were unlikely to come into conflict as long as there was enough land that all of them could practice their livelihoods without impinging on one another. As the NMFP became a major economic presence, conflict naturally developed between those who were gaining benefits from it and

[21] Ardos are the leaders who represent the Fulani grazers. They have some power due to a level of respect given to them, but they do not control the other Fulani. By offering suggestions and through discussion they had influence, but their advice, especially on the issue of grazing within the reserve, was often ignored.

those who received no benefits, but rather felt their ability to continue their own occupation to be negatively affected by the presence of scientific researchers.

Cows and the aftermath of their passage through the forest are common scenes in Ngel Nyaki, even though officially they are banned from the reserve. Conflict between conservation efforts and pastoralists can develop for many reasons; damage to wildlife numbers, damage to livestock by wildlife, disease transmission, competition for resources or overgrazing (Homewood and Rodgers, 1984). In the case of Ngel Nyaki there is little competition between wild animals and livestock for resources, in large part due to the large scale reduction in wildlife numbers that occurred several decades ago. Overgrazing however is an ongoing problem throughout the region that is also cited by conservationists as a reason to preserve land such as Ngel Nyaki in order to prevent further soil damage. However, the main area of conflict between conservationists and pastoralists in the area is that any allowance of grazing in the reserve will lead to demands by other groups to be given access to the area. Additionally, although the grazers claim to have been in the forest for generations, the other people located in Yelwa say instead that the pastoralists arrived later in order to take advantage of land made available by the removal of people from the forest by the government. Even if the NMFP were able to come to an agreement with the Fulani that allowed grazing within the forest it would not be functional due to objections by other tribes. This is true for any agreement made, any policy aside from total exclusion seems unlikely to be a long-term solution. If the research station continues to function it will have to gain the support of the government as well as engage with all the local groups so that each is able to see some advantage to supporting the reserve.



Map 2: Known cattle incursions into the forest reserve.

The majority of the enforcement of reserve boundaries is done by the patrollers rather than the field assistants. However the field assistants do participate in some ways. One day when a cow suddenly appeared at the field station it was up to field assistants to return it to the area outside of the reserve, and they were also responsible for marking the boundaries the reserve. Before I arrived at the field station a number of plants had been planted to mark the reserve boundary and keep cows on the neighbouring land, but these plants had been removed by herders in short order. So instead the NCF used field assistants to spray the herbicide along the boundary, an action which brought them into direct conflict with the local herdsman. As

field assistants are forced to take a side in this conflict, that of keeping cows out of the reserve, it limits the available number of field assistants. Those Fulani who have cows that use the reserve are unlikely to send their family members to work there. One Fulani field assistant who did work at the NMFP, Wasulu, did so because he enjoyed the work and valued it more than supporting other herders. His cows were also located a significant distance from the reserve itself and therefore were unaffected by boundary enforcement. In order to maintain their livelihoods, the field assistants must work to preserve the forest and prevent disruption in the NMFP.

The community that the NMFP wants to involve in forest management and work with in other ways is divided in a variety of ways. This is not helped by the incomplete influence of scientific knowledge on the area. Formal education is highly valued by researchers coming to the field station and villagers alike. However formal education is not valued by those who employ field assistants, who prefer practical skills. Science is valued as a conservation tool, but no local people are encouraged to fully participate in the production of scientific knowledge, instead they are either receivers of pre-produced knowledge or they are involved only in the data collection phase. The knowledge systems of grazers and farmers are also greatly different, as they interact differently with the NMFP, the forest and economic and political forces. They also live vastly different lifestyles, which leads to different values on the same objects. Previously, under certain local conditions, these different knowledge systems were able to coexist, but as happened on other parts of the Mambila Plateau, different values and ways of knowing can lead to violent conflict.

Primate Problem

A strict conservation policy conflicts with the livelihoods of those beginning to adopt the paradigm. While they accept that forest and animal conservation is important, they also have to deal with the realities of this conservation. Along with lower quality farm land and limited access to meat and other foods from the forest, there are also increased numbers of primates. It is possible that residents may agree with the paradigm in principle, except for the parts that negatively impact their lives. Compared to scientists, who have most aspects of their life and homes already arranged around science, adhering to the paradigm requires a much greater commitment.

Those at the NMFP focus more on biodiversity conservation than the impact of the reserve on local people. As conservation of the forest has become more successful it has begun to cause other problems for those living nearby. Primate populations are increasing within the reserve as bans on hunting and trapping are implemented and habitats are left mostly undisturbed. This has led to an increased demand by the primates for food. Although raiding of farms by primates has been acknowledged as a problem that has always existed to some extent in the area, increasing populations combined with a ban on killing the offending primates has caused crop raiding to become a more pressing concern for local farmers that looks likely to get worse in the future. In order to try and combat the crop raiding, villagers have come up with a number of solutions, none of which are effective. Building scarecrows works for a day, until the primates observe that they aren't moving so must not be real people, or a threat. Noise makers, children in the fields and dogs are all only temporarily effective. Villagers who poisoned bananas in an attempt to kill the primates illegally, but with little chance of being caught, reported that the primates refused to eat them, so they abandoned that plan. Researchers at the field station have done almost nothing to try and solve this problem. Most involved in the project claim to have no knowledge of the problem even existing, this includes researchers who are involved with primates and have been visiting the station for multiple years. A programme was briefly initiated to address the problem, Oliver was sent to the village to conduct interviews to try and determine the extent of the problem. However due to a lack of interest by supervisors and the difficulty in setting up data collection it was quickly abandoned. Scientific knowledge about primate behaviour was not applied by the NMFP to solve the problem and the residents have not been trained well enough in experimentation, and lack the supplies to start their own large-scale attempts to solve the problem. Scientists are focused on data collection and experimentation within the forest rather than encouraging the spread of scientific technique to the local people. Due to the relatively short periods of time that most people spend in the area, their lack of interaction with local people who aren't field assistants, and the time constraints put on them to finish their own academic work, researchers are unlikely to begin solving local problems, unless they are able to build an academic paper around it. Local people who have been well educated could be trained in the scientific method and given access to academic literature in order to solve problems such as these, but it is likely that anyone well enough educated to study academic literature in English would be employed elsewhere and not have the time or inclination to deal with practical local problems.

Conclusion

Although there are aspects of scientific knowledge in the perspectives of all those groups affected by the forest, the access to that knowledge is not evenly distributed. Researchers have full access to the forest, are able to collect data and form conclusions from these data and also have access to other forest knowledge in the form of interaction with field assistants and access to research papers. People living in the village who are not employed at the reserve on the other hand have access only to the framework of conservation, through education programmes. They have limited access to the forest itself, are not able to conduct experiments or collect data and have no way to get at information that is stored in research papers or presented at conferences. Their ability to participate in the scientific field is almost completely limited.

Knowledge about the forest and value placed on various aspects of the forest are heavily influenced by local context. If local residents only contact with primates is as crop-raiding pests then they are unlikely to value them. However when this is combined with the influence of conservation education, there will be a conflict between two types of knowledge. Primates are valued within a scientific conservation framework, but this is combined with the practical local knowledge that primates are a nuisance. Researchers only interact with primates during scientific research, so will value them for what they can add to the scientific field. Directly related to the differences in opinion on the purpose of the reserve are a series of problems that are either caused by or exacerbated by the presence of the reserve and the field station.

With an ideal construction in place, scientific research station and education programmes to spread the ideas of conservation, the NMFP then has to apply its paradigm to its work. This conservation paradigm is applied to varying degrees by those involved and is affected by influences from those outside the paradigm.

There are several local issues that alter how science is practised at the field station. They come into being because of the influence of the field assistants who have not been trained in the scientific method or involved in a culture that puts an emphasis on Western science. The lack of training in the scientific method means the field assistants are not properly prepared to be responsible for collecting data. Before the arrival of scientific thinking, the trees and plants of the forest were known by local names and knowledge of the uses of each were passed through local populations. Herbalists trained and learned the names and medical uses of

plants, while the general populous knew which plants were commonly used for food. Under the scientific system used at field station, what a plant or tree can be used for by the local population is largely irrelevant to data collection and experimentation. Many of the researchers doing their fieldwork are not botanists, and therefore rely on the field assistants to provide them with information about the names of the trees in the forest. These scientific names are something they learned from former researchers and other field assistants. Beyond being categorised and formed into data, the trees no longer have any relevance to the everyday lives of anyone forming knowledge about the forest. Plants and trees that are locally known for their uses are now catalogued by field assistants without context as to why they are important.

A major hurdle to the organisation of flora data is the overwhelming number of species that are unidentified according to the international scientific system. The majority of trees and plants in the forest have no scientific name attached to them, leaving them and their seeds unclassifiable by field assistants and researchers. There are current attempts to photograph and preserve the unknown plants and their seeds so they can be identified in the future. However large portions of data that are being collected are useless, without a naming system there is no way for unidentified seeds to be described and the information catalogued. Another problem that this causes is when there is collaboration between different projects at the station. When an unidentified seed or tree is found, it is supposed to be given a specific unknown number which is linked to that seed and the tree it comes from until an appropriate classification can be made. In reality multiple names are given to a single unknown seed, some related to the standard unknown classification system, some created by the person collecting data. Additionally I observed disagreements between pairs of field assistants over the classification of certain seeds. The data that each was recording reflected their own opinions on the correct classification, an issue that would not be known by a researcher looking at the raw data. Data that may be collected in a scientifically appropriate way may no longer be so when it is added to a larger collection of knowledge. In practise, local biological classification systems have been found to be quite similar to western systems (Zent, 2009:25). By exploring the local naming of flora, it might be possible to use local knowledge to fill gaps in the scientific naming system. As well as involving local people in the forest management and increasing interaction between the local community and the research station, it would increase the usability of data that is currently being listed as unknown. Additionally, exploring the modes of classification used locally could provide interesting

information about how people interact with the forest, and that could in turn provide useful information about the local environment that could help with future conservation efforts.

English comprehension is limited among the field assistants. The use of scientific language by researchers instead of common English makes communication even more difficult. One field assistant had been doing primate observation alone for several months, recording each behaviour onto a pre-prepared worksheet. The worksheet listed six behaviours, of these the field assistant was unaware of the meaning of two of the words listed on the sheet, locomotion and foraging. Both of these words were scientific terms for actions that could also have been described using common English words that he did know. Due to this oversight there were months of data that were inaccurate, something the researcher using the data was unaware of. The problem of comprehension is exacerbated during the rainy season as few researchers are present at the field station to provide help and there are long periods of time where data cannot be collected due to heavy fog. During my time at the station there was a period of more than two weeks when no data could be collected, which increased the likelihood that a field assistant would forget the definitions of words that he would have no other exposure to.

The field assistants that I spoke to understood how to perform the scientific techniques they were assigned. However whether they understood the basis behind the techniques depended greatly on the researcher who assigned each task. Most researchers did not fully explain the purpose behind their research, leaving the main collectors of data to be unaware of the science behind their work. As the field assistants perform most of their work alone, without supervision or extensive contact with the researcher, any problems that develop in the field have to be solved by a person who is not in possession of all the background information. Additionally the field assistants never see the results or conclusions that are created from the data they have collected. Academic papers are written and are available at the field station, but they are written in academic language and according to the academic standard for biological scientific papers which makes them difficult for anyone outside of the field to understand. The field assistants with primary school educations and poor English language skills are effectively blocked from seeing the conclusions.

Those people responsible for the major transfer of scientific knowledge, the field assistants, are not fully invested in the scientific system. They are still resident in their local system of knowledge. When the basis of the scientific knowledge at the station is being created by those

not invested in the scientific system it increases the possibility that the scientific knowledge system the research station bases its production of work on is not entirely scientific, and has instead been altered by local knowledge systems.

As well as exerting some control over information about the forest, the programmes associated with the reserve also influence economic issues. After limiting the resources available from the forest, it became necessary to replace them with new economic schemes. One such scheme that was created was beekeeping. Previously villagers had collected honey from the forest, but as they were excluded a scientific replacement was put in place. Beekeeping techniques were taught to some villagers and they were supplied with the basic requirements for starting a hive. A beekeeper I spoke to told me that his honey production has increased tenfold since he began and that he considers the project successful. However honey production has not been completely successful. In order to maintain hives, building and other supplies are required. These must be paid for, which is only possible for people who already have an income. It also increases the cost of honey for non-beekeepers as they can no longer collect their own and must purchase it. Rabbit husbandry had the same effect, a project designed to replace lost forest resources caused participants to become more tightly bound to other imported projects such as micro-loans. One main complaint regarding these programmes was a lack of support after the initial set-up, and a lack of education regarding exactly what the projects entailed. Illiterate people with no past experience in business were provided with money to start businesses, not given support and then expected to pay back loans even after their business had failed. One aspect of knowledge that is more widely accepted is that experts are seen as the ones who are seen as the only ones who should be solving problems. This is typical of a knowledge society (Knorr Cetina, 1999:5). Representatives of the reserve, from the NMFP, the NCF or the government are relied upon more heavily as the economy and politics in the region change.

Chapter 5. Conclusion

The Role of Scientific Knowledge on Conservation Practice

Knowledge is how a person interacts with the world. If the knowledge system a person uses to construct the world is that of Western science then they use a series of concrete rules to determine what knowledge is valid, and to explain how the world works. It provides a framework through which practical problems are solved. Knowledge systems are not fixed, they are influenced by interaction with other knowledge systems and by local context. In this thesis I addressed the way in which knowledge is constructed and how it is shared between people. I looked at the ways in which using different knowledge systems can alter values and perspectives, and the tensions that can be caused by having different viewpoints.

The NCF and NMFP bring adult education in the areas of literacy, business skills and conservation the people of Yelwa as well as supporting education for the youths. Although significant knowledge is present in the village, including the herbalists' extensive knowledge of trees and plants and hunters' knowledge of the forest, this is being overtaken by scientific knowledge that is brought in from other areas of the world. Education programmes are based on ones that have been put into place elsewhere and are based on western systems of knowledge. Interaction between the people of Yelwa and the NCF is quite one-sided, with villagers being given few opportunities to express their opinions or affect the direction of the programmes being put in place. As the people have been separated from the forest, with no opportunities to interact with it, their local knowledge becomes less relevant and gives way to scientific knowledge.

Those designing conservation programmes are heavily invested in science. Both organisations that are involved in the reserve agree that conservation is best defined and achieved in a way that promotes both scientific research and biodiversity. This means they view the forest as being made up of various parts that can be researched individually in order to give a picture of the forest as a whole. As the reserve is a the largest local employer, there are incentives for local people to support the views of those who have control over the reserve, something that is compounded by the education campaigns designed to enforce the ideals of scientific conservation.

The influence of scientific knowledge on local people is also clear. Local people look to outsiders for solutions to their problems. When asked for their opinions on how to solve local problems, some villagers insisted it was for me to tell them. They did not see it as their job to solve local problems, rather they should wait for someone with outside authority to solve it for them. The reasons behind this reliance on experts are unclear. It's possible that education and the influence of the NMFP have convinced local people that scientifically is the best way of looking at problems, or it could be due to an expectation that no matter what they think is the best solution, one will be forced upon them by those people with money and political influence. With little information being passed to the people in the village, and a lack of communication between community leaders and those making policy regarding the reserve, it is understandable that the villagers may feel they lack control over their own situation.

Problems continue to develop as even those who are trained to high levels must have access to money and supplies in order to carry out research at the levels they've been taught in graduate school. They also have not been taught to incorporate the people who are to be dealing with the results of their scientific and technological innovations. This means that even things that are theoretically ideal solutions to problems may fail due to social, political or economic influences.

How the NMFP Produces Knowledge

Science knowledge is a distinct form of knowledge that interacts with local knowledge systems. Using science knowledge impacts the way the research station implements its policies. The spread of scientific ideas also influences how conservation policy is received. Science functions as a very specific type of knowledge due to the actions of those involved in it. Experts have specialised in particular areas of knowledge, they have bound themselves together through education, research and by following specific ways of collecting and analysing information in order to produce a view of the world that can then be given to outside groups. Modern science is not as international and context-free as it is expected to be, and is rather controlled by local issues and people (Williams, 2000:503). In the case of the NMFP there are local bounds on how science knowledge is produced from both the environment and the local people. Weather has a strong influence on the data that is collected and used to form conclusions about the forest and its inhabitants. During my field work there was a two week period where rain and fog prevented any data from being collected. Any

conclusions drawn about the forest will be changed by the gaps in data forced by local conditions. Conclusions are also reliant on the accuracy of the field assistants, and the communication between field assistants and researchers. Confusion between the two can lead to inaccurate results and faulty conclusions. The scientific knowledge is also confined by the forest itself and the wildlife within it. Areas that are extremely remote or are difficult to access make data collection difficult. In the case of some primates, their movements are difficult to predict and individuals are hard to identify. For those researchers looking at chimps, nearly all the data is collected hours or days after they have left, as actual observation is rare. Context is necessary to understand accurately the conclusions that are to be drawn from Ngel Nyaki and added to general scientific knowledge.

The scientific method is taught to local people through schools. Programmes designed to teach the scientific method involve data collection and generation and testing of hypotheses (Rice, 1985) .Only the paradigm itself is taught by the NMFP, not the thought behind it. Performing science hands on is an effective way to learn and become involved in the scientific process. However by ignoring the hypotheses formation and testing aspect of the scientific method, there is a distinct divide in the amount of scientific knowledge that local members of the NMFP are allowed to be involved in. Those with access to higher education are able to participate fully in sustainable management decisions regarding the forest, while those without it are not given the skills to be part of the official discourse. This leaves the employees of the NMFP, all of whom have developed extensive knowledge of the forest but lack the skills to apply that knowledge in a scientific manner, in a subordinate position to members of the NCF and those involved in academic research.

Future of the Reserve

In order to guarantee the successful future of the Ngel Nyaki forest reserve it will be necessary to resolve its most pressing tensions. Politicians have made promises that they will send teams out to clarify and remark the boundaries of the reserve. Although this would be helpful in easing tensions, based on past government action in the area it is unlikely that any such action will take place in the near future. Enforcement of existing laws would also protect the future of the reserve, as a successful end to cattle in the reserve would eliminate the border disputes and the resentment that the same rules are not being applied to everyone. However, once again this seems unlikely to happen in the near future. While it is still possible

for grazers to use money and political influence to skirt the law, there is no reason for them to stop their incursions into the reserve. A more effective way of resolving that conflict is likely to be through education and economic incentive. If everyone values the preservation of the forest, and all are gaining economically from the presence of the reserve then there will be a unified effort to maintain the reserve. This would only be possible if the research station became more financially rewarding than herding cattle in the reserve. It also relies on active interest from all involved. If very few Fulani are interested in working for the field station or participating in NCF programmes, then it will be more difficult to form a consensus on any issue. In the future, if investment in secondary education continues and more local students are able to go university, then there may be effective community involvement in management of the forest ecosystems. However unless local people are able to participate in scientific discourse, community management will be unobtainable, and local input into the future of the reserve will be limited.

Future Research

The knowledge transmission I was able to observe occurred between researchers and field assistants. As there is little legal interaction between most people in the village and the forest, there is no opportunity to view new knowledge about the forest being developed. Although I observed the ways in which scientific knowledge was transmitted, I did not focus on the transmission of local knowledge while I was conducting my fieldwork. This means I did not observe the ways in which information about the forest is passed from the elders to the younger generation. The ways in which knowledge is divided among different groups, such as men and women, within the village is another area that could be explored further. There are divisions between herbalists, grazers, farmers and hunters that are related to what is necessary for them to practice each one of those lifestyles. Each group could be further studied individually, and the impact of exclusion and increased formal education could be explored.

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